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**Contributions to the Tertiary Paleontology of
Northern Peru: Part 3, Eocene Mollusca**

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PREFATORY NOTE

This paper is Part 3 of the Contributions to the Tertiary Paleontology of Northern Peru and of which Parts 1 and 2 have already appeared in these Bulletins. A reclassification of the Peruvian Upper Eocene rocks into two stages, representing two distinct marine transgressions has been found necessary and the Introduction is devoted to a discussion of the Paleontology and Stratigraphy of these formations. In addition to the description of several new species of Eocene mollusks, the following new genera and subgenera are proposed.

Yasila Type. *Yasila paytensis*, n. sp.

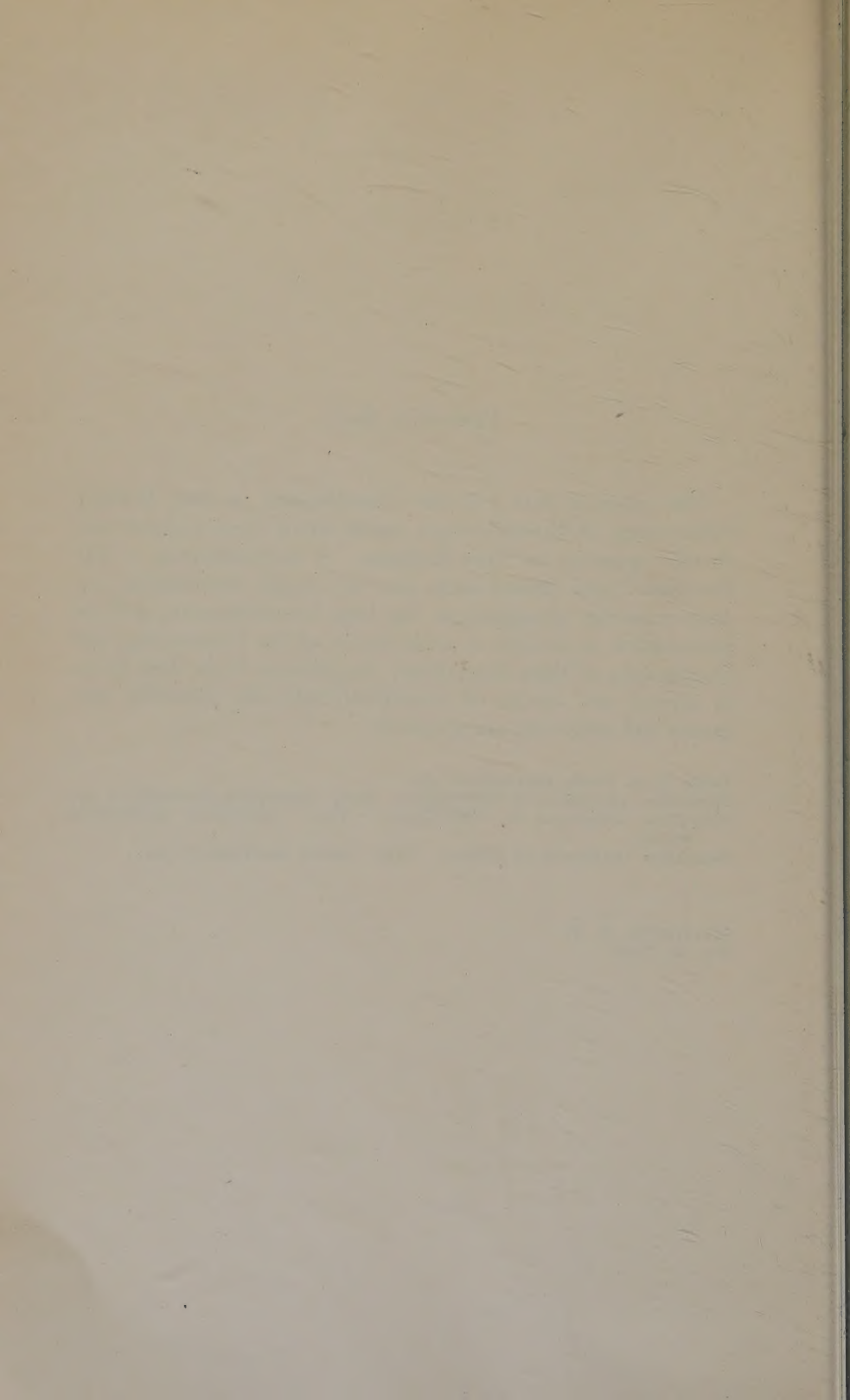
Chiralithes (Subgenus of *Clavilithes*). Type: *Clavilithes cynosuris*, n. sp.

Perulithes (Subgenus of *Clavilithes*). Type: *Clavilithes peruvianus*
Woods.

Nerinata (Subgenus of *Natica*). Type: *Natica paytensis*, n. sp.

Gloversville, N. Y.

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INTRODUCTION

The series of sedimentary deposits consisting chiefly of conglomerates, sandstones and shales which form the Peruvian Eocene, was briefly described in 1928 in Part 1, of these Contributions¹ as an aid in recording the occurrence and stratigraphic range of the fossil species of mollusca. Stratigraphically these rocks were divided into 6 formations from early to late Eocene age.

Since the publication of our sections in 1928, a great deal of new information has been secured of a faunal and stratigraphic nature and certain changes affecting the classification of the Upper Eocene rocks are necessary. Following the opinion generally held at that time, the Upper Eocene was believed to constitute a single stratigraphic unit and beds containing an Upper Eocene fauna were assigned to a single formation named the Saman. This interpretation can no longer be maintained and two formations of early and late Upper Eocene age respectively and representing two distinct marine transgressions across the littoral region of northern Peru must be recognized. The two-fold division of the European Upper Eocene deposits into the Bartonian and Ludian stages, heretofore not separated in America, seems to find a parallel in northern South America.

In the new or revised classification, the Verdun grits of the Negritos region, formerly referred to the Lower Oligocene, are correlated directly with the typical Saman formation of the Chira Valley. The beds formerly referred to the Saman in the Negritos and coastal region are now known to belong to an older formation which may be called the Talara formation; a name first used by Grzybowski². The outcrops which may be selected as typical for the Talara formation, are the shales and sandstones lying above the Upper Eocene unconformity or beginning with the *Discocyclina peruviana* zone as exposed along the east side of the Talara Golf course and extending east and then north along the tablazo escarpments.

¹Olsson, 1928, Bulls. Amer. Pal., vol. 14, no. 52.

²Grzybowski, 1899, Neues Jahrb, für Min., etc., BB. bd. 12, p.

THE SAMAN FORMATION

The type exposures of the Saman formation are the fossiliferous yellow sandstones of Casa Saman near Tangara in the Chira valley and extending northeast as a series of strike hills past Sullana and Quercotilla to Sojo. They have a thickness of about 1000 feet and consist chiefly of sandstones and conglomerates becoming more argillaceous and fine-grained towards the top. In this region, they rest directly upon the Cretaceous (Copa Sombrero formation) or on the Amotape slates and granites along the south side of the Amotape Mountains. The typical Saman sandstones are also found at Paita, representing coastal rocks resting on slates and mica-schists. Small exposures of Saman sandstones are found around the borders of the Cerros de Illescas resting upon metamorphics and igneous rocks. The largest exposures are found at Nonura bay, the basal bed being usually a beach limestone filled with *Lepidocyclina*.

Fossils principally mollusks are common in the Saman sandstones throughout the Chira valley. Many species such as *Aturia alabamensis* var. *peruviana*, the *Pseudoliva*, *Venericardia planicosta* var. *samanensis* and *Amotapus arbolensis* are unusually large and represent the highest stage attained in the evolution of these forms. The following species have been collected in the Saman sandstones at Casa Saman.

†*Arca (Argina) sullanensis* Woods

†*Arca (Argina) samanensis* Olsson

**Pteria* sp.

Mytilus sp.

†*Ostrea samanensis* Olsson

†*Amotapus arbolensis* Woods

†*Venericardia planicosta* var. *samanensis* Olsson

**Cardium samanicum* Olsson

**Phacoides (Miltha) paytensis* Woods

††*Clementia peruviana* Olsson

**Macrocallista inca* Olsson

**Pitaria (Lamelliconcha) samanensis* Olsson

†*Spisula (Oxyperas) callistoides* Olsson

Tellina sp.

Solen sp.

**Corbula tangara* Olsson

- †‡*Architectonica sullana* Olsson
- †‡*Architectonica chira* Olsson
- **Polinices* (*Neverita*) *samanensis* Olsson
- †*Ampullina orton* Gabb
- †*Ampullina gabbi* Woods
- **Claytræa saxosa* Olsson
- Crepidula* sp.
- †‡*Turritella samanensis* Olsson
- †‡*Turritella chira* Olsson
- **Turritella boughtoni* Olsson
- †*Cerithium* (*Iddingsia*) *læviusculum* Gabb
- **Lagunitus peruvianus* Woods
- **Lagunitus samanicus* Olsson
- †*Ectinochilus gaudichaudi* d'Orb.
- †*Peruficus lagunitensis* Olsson
- †‡*Pseudoliva parinæensis* var. *samanica* Olsson
- †*Pseudoliva coronaria*, n. sp.
- **Tritonidea staufti* Olsson
- †*Dorsanum lagunitensis* Woods
- †*Melongena* (*Cornulina*) *lævifusoides* Olsson
- **Melongena* (*Pugilina*) *ædicnema* Olsson
- ‡*Mancorus grabaui*, n. sp.
- †‡*Voluta* (*Peruluta*) *mancorensis* Olsson
- †*Agaronia inca*, n. sp.
- †‡*Conus chirænsis* Olsson
- †‡*Xancus peruvianus* Olsson
- †‡*Aturia alabamensis*, var. *peruviana* Olsson

†Also in Talara form.

*Restricted to Saman sandstones.

‡Also in Chira or higher Oligocene formations.

The above list records 43 species. The majority or approximately 60% are species which have ascended from the older rocks and of which nearly 44% are forms first appearing in the Lower Upper Eocene or basal Talara formation. About 26% are long ranging forms passing into the overlying Oligocene and having no particular significance. Only 13 species or 30% seem to be restricted to Saman rocks. The above tabulation is somewhat inaccurate as certain species recorded both from the Talara and Oligocene formations have not been collected in the

Saman sandstones but their addition would not greatly change the relationship already indicated. The very close affinities of the Saman fauna with that of the Lower Upper Eocene or Talara formation is very evident.

The typical Saman sandstones do not occur in the coastal region north of the Chira valley but become replaced by shales and white to yellowish gritty sandstones showing great lateral variation and in thickness ranging from 1500 to 3000 feet. In some localities small *Lepidocyclina* and *Nummulites* (the Verdun grits) are common but other fossils are very rare or generally too fragmentary for specific identification. North of Mancora, the Verdun rocks become coarse conglomerates passing into mudflows in the Canoas and Caletto Mero region. Since they are the surface rocks in the Verdun field, they were named the Verdun formation.

An unconformity of regional character marks the base of the Verdun formation. This unconformity varies according to local structure but in general increases in magnitude to the north indicating that the Verdun transgression came from the southwest. At Caletto Sal, an erosional interval preceding the deposition of the Orbitoidal conglomerates is indicated in the abundance of rolled fossils such as *Pseudoglauconia lissonii* of Restin origin, showing that these older beds were exposed to erosion. In the Negritos region, the Verdun unconformity is an important factor in the producing districts and drilling wells frequently find a large part of the normal section missing. The more complete sections generally exposed in synclinal areas or in down-faulted blocks have the Verdun grits resting upon a variable thickness of Pozo shales belonging to the upper part of the Talara formation.

The correlation of the Verdun grits with the Saman sandstones of the Chira valley has been complicated from the lack of exposures in the intermediate region since these formations lie deeply buried beneath Oligocene and Pleistocene deposits. The most conclusive evidence of the equivalence of these rocks is furnished by the Lagunitas sandstones of Lagunitas. They are coarse, gritty sandstones similar to those of the Verdun and contain many *Nummulites* and some *Lepidocyclina* and at Triangulation Station 40 in Lagunitas numerous mollusks similar to those of the Saman sandstones. They are directly overlain by the Chira

shales and according to well sections form the upper part of an Orbitoidal section of grits and arenaceous shales about 600 feet in thickness which clearly belongs to the Verdun formation. Beneath these Orbitoidal beds, drilling wells pass into the Talara formation, easily recognized by its fauna of *Discocyclina peruviana* and other special fossils. The Lagunitas sandstone therefore must belong to the Upper part of the Verdun formation or to the Second and Third grits of the Jabonillal region.

1. †† *Arca samanensis* Olsson
2. *Glycymeris*, sp.
3. †† *Ostrea samanensis* Olsson
4. ††† *Venericardia planicosta*, var. *samanensis* Olsson
5. † *Pitaria samanensis* Olsson
6. ††§ *Conus chirænsis*, n. sp.
7. *Scobinella*, sp.
8. * *Olivancillaria peruviana* Woods
9. † *Plejona (Volutocorbis) sula*, n. sp.
10. *Melongena*, sp.
11. †† *Dorsanum lagunitensis* Woods
12. †† *Pseudoliva samanica* Olsson
13. †† *Sconsia?* *samanica* Olsson
14. § *Morum peruvianum*, n. sp.
15. †† *Ectinochilus gaudichaudi* d'Orb.
16. *Cerithium*, sp.
17. †† *Cerithium (Iddigsia) lævisculum* Gabb
18. †† *Turritella chira* Olsson
19. †† *Turritella samanensis* Olsson
20. †† *Ampullina ortonii* Gabb
21. * *Tympanotomus lagunitensis* Woods
22. *Faunus ? lagunitensis* Woods
23. * *Lagunitas peruvianus* Woods
24. †† *Lagunitas samanica* Olsson
25. ††§ *Architectonica sullana* Olsson
26. ††§ *Architectonia chira* Olsson
27. * *Terebra*, sp.

** Also pre-Talara.

† In Talara formation.

‡ In Saman sandstones.

§ In Oligocene.

* Restricted to Lagunitas sandstones.

THE TALARA FORMATION

The distribution of the Talara formation is restricted to a narrow coastal belt beginning at Yasila and Jaquay Cunas a few miles south of Paita and extending north to the Tumbes river. In Ecuador, the shales which immediately lie beneath the clay-pebble bed of Baldry and Sheppard more than likely belongs to the Talara formation although its typical fauna has not been recognized.

In most places, a three-fold division of the Talara formation is recognized, a middle sandstone member (the Talara sandstones) between underlying and overlying shales. In a complete section, the Talara formation has an average thickness of about 2800 feet and has been divided as follows:

	<i>Revised</i>	<i>Old</i>
Talara formation	Pozo Shales	Pozo Shales
	Talara Sandstones	Saman Sandstones
	Talara Shales	Saman Shales

The Talara sandstones show great lateral variation from massive, hard, blue sandstones with cannon-ball concretions (Talara and Lobitos) to heavy-bedded flagstones and platy sandstones or to thin-bedded papery sandstones and shales. The sandstone layers are frequently ripple marked or covered with fucoïdal markings indicating deposition in very shallow waters or tidal flats. Towards the top, the Talara sandstones pass into the Pozo shales laid down in somewhat deeper waters. The Pozo shales and the Talara sandstones are convenient lithological units in areal mapping but since they contain no fossils aside from foraminifera, need not be further considered in this paper.

The lower division or the Talara shales are principally dark-colored or gray shales, sometimes passing into sandstones or even conglomerates at their base. In some cases these sandy basal layers may reach a thickness of 400 feet or more, becoming a very important oil horizon known as the Lomitos conglomerate. It is principally from these lower beds that the bulk of the Talara molluscan faunas has been obtained. Mr. Willard Berry³

³Willard Berry, 1928, *Eclogae geologicae Helvetiae*, vol. 21, pp. 390 to 405.

has described the foraminiferal fauna of the Talara shales.

In the entire coastal region, an unconformity marks the base of the Talara formation. This unconformity is beautifully exposed at Yasila⁴ and Jaquay Cunas where the basal Talara rocks consisting of yellow sandstones containing an abundant fauna, rest either on slates or on small remnants of the Salina beds (Lower Middle Eocene) preserved in small down-faulted blocks amongst the older slates and granite. The Pale Gredas, Parinas and Restin formations appear to be entirely absent in this region. West of Lagunitas, the Talara unconformity is exposed along the east side of the Keswick Hills as a zone of coarse, black, quartzitic cobbles in arenaceous shales resting upon eroded Restin shales. From this point, this unconformity may be traced in surface exposures north of the Great Fault of Bosworth through numerous fault blocks nearly to Talara. It is well exposed in the shale cliffs on the east side of the Talara Golf Course, as a sandy zone containing *Discocyclina peruviana* and *Nummulites speciosus* lying on somewhat more steeply dipping Restin shales. North of Mancora, the basal Talara formation contains lenses or reefs of Lithothamnium limestones.

The importance of the Talara unconformity marking the base of the Upper Eocene in Peru, has been emphasized in our former writings. It is unquestionably the most important stratigraphic break in the entire Tertiary history of this region, indicating vast changes in the tectonic development of northern and western South America. Master faults were formed at this time in the Negritos region which strike generally north and south or parallel to the major foldings of the Andean Geosyncline. Since the Upper Eocene, structural development has followed along other lines with trends usually parallel to the present coast-line.

As previously stated, the bulk of the Talara fauna has been obtained from the basal sandy or conglomeritic layers, the horizon of the Lomitos conglomerate or the *Liothyryna peruviana* -- *Discocyclina peruviana* zone. A few fossils have also been collected from certain gritty layers of local development near the top of the Talara shales but these are relatively unimportant. The

⁴Yasila and Jaquay Cunas. These are two localities lying about 8 to 11 kilometers respectively southwest of Piata along the coast between Punta Nermete and Isla de Foca. They are shown on the Piata sheet of the Peruvian Servicio Geográfica del Ejército 1925.

best fossil localities are the following:

- Y. Yasila and Jaquay Cunas southwest of Paita.
- N. Salina area at the southwest end of the Negritos Golf Course, Negritos.
- L. About 2 to 3 miles northwest of Lagunitas.
- G. North side of Great Fault $\frac{1}{2}$ mile northeast of Section 23, Negritos, zone of *Operculina* and other fossils.
- T. Talara Golf Course and near southeast corner of Talara tank farm.
- Lo. Lobitos.
- B. Cabo Blanco, banks of Que. Siches.
- C. Caleta Sal.

The following lists includes all the fossil species except the smaller foraminifera and the undetermined crustacea, corals and echinoids known from the Talara formation. The capital letters following the species refer to the localities tabulated above. The prefixes * † ** § indicates the stratigraphic range of the species as follows:

- * Restricted to the Talara formation
- † Ascending from the Restin or older beds
- ** Continuing into the Saman formation
- § Passing into the Oligocene

Pelecypoda

1. **Leda*, sp., Y
2. **Leda* (*Adrana*), sp. Y, T
3. ***Arca* (*Argina*) *sullanensis* Woods, T
4. ***Arca* (*Argina*) *samanensis* Olsson, T
5. **Glycymeris peruvianus*, n. sp., Y
6. ***Ostrea samanensis* Olsson, Y etc.
7. **Anomia*, sp., N
8. **Mytilus*, sp., N
9. **Atrina talarensis* Olsson, T
10. **†*Amotapus arbolensis* Woods, N, Y, C
11. **Venericardia*, sp., L
12. **Venericardia simillina*, n. sp., Y
13. **†*Venericardia planicosta* var. *samanensis* Olsson
14. **Cardium*, sp., L
15. **Cardium junceum*, n. sp., Y
16. **Phacoides* (*Here*) *andersoni*, n. sp., Y
17. §*Phacoides* (*Miltha*) *woodi*, n. sp., Y
18. §**†*Clementia peruviana*, n. sp., Y, N, C, T, etc.
19. **Pitaria* (*Pitaria*) *yasila*, n. sp., Y

20. **Pitaria* (*Lamelliconcha*) *salsola* Olsson, N, Y
21. **Pitaria* (*Lamelliconcha*) *baldryi*, n. sp., Y
22. **Macoma* (*Psammacoma*) *talarensis* Olsson, T
23. **Corbis*, sp., B
24. **Spisula* (*Spisula*) *caleta* Olsson, C
25. **Spisula* (*Spisula*) *hualtaca* Olsson, C
26. **Spisula* (*Oxyperas*) *deserta* Olsson, Y, C
27. **Mactra* ?, sp., N, Y
28. **Corbula*, sp., Y
29. **Corbula boggsi* Olsson, N
30. **Corbula salina* Olsson, N
31. **Ens's*, sp., N
32. **Verticordia*, sp., L
33. **Martesia*, sp., N

Gasteropoda

1. **Conus peruvianus*, n. sp., Y
2. §***Conus chirænsis*, n. sp., Y
3. **Drillia parina* Olsson, N
4. **Daphnella salina* Olsson, N
5. **Eopleurotoma paytensis*, n. sp., Y
6. **Eopleurotoma wiedeyi*, n. sp., Y
7. **Hemipleurotoma arenosa*, n. sp., Y
8. **Moniliopsis peruviana*, n. sp., Y
9. **Moniliopsis* ? *paytensis*, n. sp., Y
10. **Crassispira woodringi*, n. sp., Y
11. **Crassispira capella*, n. sp., Y
12. **Turricula* (*Pleurofusua*) *eolavinia*, n. sp., Y
13. **Fusiturricula yasila*, n. sp., Y
14. §*Genotia peruviana*, n. sp., Y
15. **Scobinella* (*Mitratoma*) *bartschi*, n. sp., Y
16. **Terebra negritensis*, n. sp., Y, N
17. **Terebra*, sp., Y
18. **Cancellaria* (*Admete*) *paytensis*, n. sp., Y
19. **Oliva* (*Oliva*) *misti*, n. sp., Y
20. **Agaronia saxosa* Olsson, L
21. ***Agaronia inca*, n. sp., N, Y
22. **Ancillarina pananga*, n. sp., N, Y
23. **Voluta paytanica*, n. sp., Y

24. †*Peruluta peruviana*, var. *samanica* Olsson, N
25. **§*Peruluta mancorensis* Olsson, Y
26. **Plejona (Volutocorbis) sula*, n. sp., Y
27. **Lyria sabulosa* Olsson, N, G, L
28. †*Lyria busera*, n. sp., Y
29. **Mitra (Tiara) yasila*, n. sp., Y
30. **Eoxancus talarensis*, n. sp., Y, T
31. **Eoxancus paytensis*, n. sp., Y
32. **†§*Xancus peruvianus* Olsson, C
33. **Clavilithes woodringi* Olsson, L
34. **Clavilithes lagunitensis* Olsson, L
35. **Perulithes yasila*, n. sp., Y
36. §*Chiralithes cynosuris*, n. sp., Y
37. **Chiralithes pozoensis* Olsson, L
38. ***Peruficus lagunitensis* Olsson, Y
39. †*Levifusus mallacus* Olsson, L
40. **Typhis (Levityphis) thagus*, n. sp., Y
41. **Murex scorpionius*, n. sp., Y
42. **Yasila paytensis*, n. sp., Y
43. **Siphonalia (Pseudoneptunea) nuntia*, n. sp., Y
44. **Terebrifusus placitus*, n. sp., Y
45. **Terebrifusus lepus*, n. sp., Y
46. **†*Melongena (Cornulina) levifusoides* Olsson, Y
47. ***Dorsanum lagunitensis* Woods, N, Y
48. **Tritiaria salina* Olsson, N
49. **Tritiaria terebratula* Olsson, N
50. **Pollia sillapaytensis*, n. sp., Y
51. **Pollia (Endopachychilus) purpuroides*, n. sp., Y
52. **Pseudoliva*, sp., Y
53. ***Pseudoliva samanica* Olsson, N, Y, L
54. **Pseudoliva modesta* Olsson, N
55. ***Pseudoliva coronaria*, n. sp., Y
56. **Bursa chira*, var. *yasila*, n. var., Y
57. **Sassia*, sp., Y
58. **Plesiotriton paytensis*, n. sp., Y
59. **Ficus otaria* Olsson, N, Y
60. ***Sconsia ? samanica* Olsson, N, Y
61. **Morum (Herculea) maccormacki* Olsson, L
62. **Amphiperas bullen-newtoni*, n. sp., Y

63. **Amphiperas negritensis* Olsson, N
64. **Cypræa boggsi* Olsson, L
65. *Cyprædea*, sp., Y
66. **Ectinochilus gaudichaudi*, var. *alauda* Olsson, N, Y
67. ***Cerithium* (*Iddingsia*) *lævisculum* Gabb
68. †*Harrisianella peruviana* Olsson, C
69. §***Turritella chira* Olsson, N, Y
70. §***Turritella samanensis* Olsson, N, Y
71. **Turbo*, sp., Y
72. †*Natica* (*Natica*) *peruviana* Olsson, N, Y
73. **Natica* (*Nerinatica*) *paytensis*, n. sp., Y
74. **Polinices* (*Polinices*) *woodi* Olsson, N
75. ***Ampullina orton* Gabb, Y
76. **Tuba peruviana*, n. sp., L, Y
77. §*Liotia*, sp., Y
78. §***Architectonica sullana* Olsson, Y, N, etc.
79. §***Architectonica chira* Olsson, Y, N, etc.
80. **Epitonium* (*Acrilla*) *peruvianum* Olsson, N, Y, L
81. **Epitonium* (*Acrilla*) *paytens*, n. sp., Y, L

Cephalopoda

1. §***Aturia alabamensis*, var. *peruviana* Olsson, N

Scaphopoda

1. **Cadulus*, sp., Y
2. **Dentalium saman* Berry, L
3. **Dentalium boggsi* Berry, L
4. **Dentalium yasium*, n. sp., Y

Brachiopoda

1. **Liothyryna peruviana* Olsson, L, N, Lo, C. B
2. **Argyrotheca berryi* Olsson, C
3. **Argyrotheca chica* Berry, C

Foraminifera

1. **Discocyclina peruviana* Cushman, L, T, Lo, B, C
2. **Discocyclina salensis* Berry, C
3. **Asteriacites caleta* Berry, C
4. **Asterodiscocyclina stewarti* Berry C

Most of the species recorded above, were collected near Negritos, Lagunitas or Yasila. Although maintaining a general faunal characteristic, even nearby localities will show certain variations so that each station has its individual elements. At Yasila, the most common fossil is *Turritella chira* while a mile to the north, the same layers contain a pelecypod fauna with *Amotapus arbo-lensis* Woods and *Spisula deserta* as outstanding members. The same variations are found through the Negritos and Talara regions with even more striking differences. Near Lagunitas, the lower Talara shales contain zones filled with *Liothyryna peruviana* and *Discocyclina peruviana* and a rich molluscan fauna of *Clavilithes*, *Morum*, a small *Venericardia* and *Verticordia*. Just north of the Great Fault near Section 23, are sandy layers filled with *Operculina* and a small *Lepidocyclina* while molluscs are quite rare. Between this station and the Talara Golf course, the beds are nearly unfossiliferous consisting principally of shales but at the Talara Golf course, the rocks become filled with *Discocyclina peruviana* and *Nummulites speciosa*. Somewhat higher, a molluscan fauna with *Clementia peruviana*, *Atrina talarensis* and *Eoxancus talarensis* occurs in thin sandstone layers near the southeast corner of the Talara tank farm. At Caletto Sal, the basal Talara is a soft, gritty sandstone with small brachiopods (*Argyrotheca*) and stellate *Orthophragmina*. In this same region we also find lenses or reef-like masses of Lithothamnium limestones which seem to reach their greatest development in Quebrada Conchudo. The varied ecological conditions brought into being by the Talara or early Upper Eocene transgression were therefore extremely favorable to the rapid evolution and expansion of a new fauna and additions to this fauna may be expected as new fossil localities are found, embracing a larger range of ecological stations.

About 119 species of mollusks have been collected from the basal Talara formation. The majority or about 72% are known only from this horizon. A few of these species may be discovered in the Saman rocks but the larger number will probably remain strictly Talara forms. Only 9% have come up from the older beds, a few highly specialized species as *Peruluta peruviana*, var. *samanica* seem to have survived but for a short time,

while others as *Amotapus arbolensis* and *Venericardia planicosta* var. *samanensis* are longer ranging forms which pass into the Saman formation while *Clementia peruviana* and *Xancus peruvianus* although beginning in the upper Restin belong to more modern types and pass into the Middle and possibly the Upper Oligocene. About 19% represent species which pass into the Saman formation, a percentage which will probably be increased as additions are made to the Saman fauna. About 11% continue into the Oligocene most of which begin in the Talara formation. The slight affinities of the Talara fauna with the older Peruvian Eocene should be noted. It is particularly striking in the entire absence (except as rolled or reworked fossils) of several important groups of mollusks, such as the large Cerithioids (*Pseudoglauconia lissoni*, *Perucerrithium*) the Melanatrias, Carolias, etc.

The evidence of the other fossil invertebrates as far as these have been studied, is even more conclusive in proving the slight affinities of the Talara fauna with the older Eocene. Three or four species of brachiopods occur in the basal Talara, the only representatives of this class in the Peruvian Tertiaries. The larger foraminifera including 2 species of *Discocyclina*, 1 species of *Asterodiscocyclina*, 1 or more species of *Helicolepidina*, numerous *Lepidocyclina*, *Operculina* and *Nummulites*, all commence in the basal Talara while these genera are entirely absent from the underlying Eocene. The Crustacea, Echinoids and Corals have not been studied but they all appear distinct from pre-Talaran forms.

The relations of the Talara fauna with that of the Saman is close. About 19% of the Talaran mollusks recorded above, occur in the Saman, a proportion which could be increased by including a few species ranging into the Oligocene but not definitely known from the Saman. Of the Saman fauna itself, about 44% belong to Talara species.

The Talara fauna is distinguished from the Saman by its large number of special species. It includes several species of *Clavilithes* whose affinities are with the older beds. *Epitonium peruvianum* and *paytensis*, *Lyria sabulosa*, *Natica paytensis* and *Phacoides andersoni* are but a few species of mollusk which seem to be restricted to this formation. The brachiopods are entirely

confined to this formation while no species of *Orthophragmina* has been identified from the Saman or younger formations.

CORRELATION

In 1922, Cushman⁵ in his discussion of the larger foraminifera of the Bosworth collection, referred the zone of *Discocyclina peruviana* definitely to the Upper Eocene. This correlation is supported by the evidence of the mollusks and other groups of fossil invertebrates. The zone of *Discocyclina peruviana* lies near or at the base of the Talara formation and above a major unconformity. It marks the commencement of a new fauna quite distinct from the older Peruvian Eocene which continues to the top of the Saman sandstones.

It has been shown that the Talara and Saman rocks belong to distinct formations separated stratigraphically by a regional unconformity and by certain differences in fauna. They are both referred to the Upper Eocene and in terms of the European section, to the Bartonian and Ludian.

DESCRIPTION OF SPECIES

Class PELECYPODA

Order PRIONODESMACEA

Superfamily NUCULACEA

Family NUCULIDAE Adams

Genus NUCULA Lamarck

***Nucula catalina*, n. sp.**

Plate 1, fig. 2.

Shell small to medium size, solid, subtrigonal; outline like most *Nuculas* is subtruncate posteriorly with the beaks near the posterior $\frac{1}{4}$ th; ventral margin curved with its greatest convexity nearly below the umbos; beaks small and inconspicuous; surface sculpture variable, usually appearing nearly smooth to the unaided eye but on slight magnification a submicroscopic sculp-

⁵Cushman, 1922, In Bosworth's Geology of North-West Peru, p. 136.

ture is seen, consisting of quite regular concentric wrinkles, heaviest on the umbos and along the anterior portion of the valves; the spaces between these concentric wrinkles is crossed by regular, elevated radial threads; along the umbonal ridge, the concentric wrinkles may be finely divided into small broken threads; the anterior and posterior submargins are nearly smooth; interior concealed.

Height 8mm.; length 9.5mm.

Height 10.5mm.; length 12mm.

Remarks.—This species is recognized by its elegant submicroscopic sculpture. It is somewhat variable in this character, some shells being nearly smooth while on others it is persistent and strong. The species occurs with *Dentalium mancorense* *Leda barranca*, fragments of *Aturia peruviana* in certain hard, cherty layers in the Lower Talara shales of Que. Barrancas.

Locality and Geologic Occurrence.—Talara formation, Que. Barrancas.

Family LEDIDAE Adams

Genus LEDA Schumacher

Subgenus LEDINA Dall

Leda (*Ledina*) *barranca*, n. sp.

Plate 1, figs. 3, 6, 7.

Shell large, solid, corbuloid to *Yoldia*-form; umbos small ending in the small scarcely curved beaks; valves nearly equilateral, the posterior side slightly more sloping or contracted than the anterior; valves moderately convex, the greatest inflation being a short distance above the middle and frequently the surface appears slightly impressed just below the middle; lunule narrow, lanceolate, nearly as long as the anterior-dorsal margin and defined by being sunk or slightly depressed below the general surface level; escutcheon not well exposed on any of our specimens; anterior extremity well rounded; posterior side slightly constricted behind the beaks, bluntly pointed and emarginated at the extremity and weakly arcuate just in front and below; ventral margin straight in the middle, rounded on the sides; surface is smooth, except for the irregularly spaced growth-lines and occasional resting marks and more rarely submicroscopic radial wrinkles; hinge taxodont but not well enough exposed for de-

tailed description.

Length 26mm.; height 17mm.; semidiameter 5.5mm.

Length 23mm.; height 14.25mm.; semidiameter 4mm.

Remarks.—The subgenus *Ledina* Dall with *Leda smirna* Dall⁶ (*L. eborea* Conrad 1860, not 1846) as type, includes certain Eocene species characterized by their solid shell, *Yoldia*-like form with both ends evenly rounded. A recently described species of this group is the *Leda jonesi* Gardner⁷ from Sumter Co., Alabama. In *L. barranca*, the shell is quite thick and solid and peculiarly corbuloid in shape. The anterior side appears to be slightly longer than the posterior but this may not be actually the case, as the posterior side is usually more or less broken. There is a weak emargination of the posterior ventral side. The surface is polished, smoothish except for irregular growth lines. The hinge is seldom seen and always poorly exposed. In one specimen there are about 17 high taxodont teeth along the posterior-dorsal margin.

Locality and Geologic Occurrence.—Talara formation, Que. Barrancas.

Superfamily ARCAEA

Family ARCIDAE Dall

Genus GLYCYMERIS da Costa

Glycymeris peruvianus, n. sp.

Plate 1, fig. 4.

Shell small, subcircular, widest about the middle with an evenly rounded ventral margin; anterior and posterior submargins straight so that the dorsal portion of the shell appears trigonal to subpointed; shell is moderately convex, greatest just above the middle; umbos not prominent, with low, scarcely pointed beaks; surface smoothish, with numerous, subregular, low ribs or cords, separated by wider interspaces; resting marks present, showing deep, distant, concentric rings particularly on the umbos and earlier part of the shell; hinge normal with a narrow cardinal area; posterior set of taxodont teeth 8 to 11, and generally with 2 or 3 more on the anterior side; ventral margin crenulated ex-

⁶Dall, 1898, Trans. Wagner Free Inst., vol. 3, pt. 4, p. 580.

⁷Gardner 1929, Journ. Wash. Acad. of Sci., vol. 19, pp. 425-428, fig. 1.

cept along the posterior and anterior sides.

Height 14.5mm.; width 14.5mm.; semidiameter 4mm.

Locality and Geologic Occurrence.—Talara formation Yasila.

Order TELEODESMACEA

Superfamily CARDITACEA

Family CARDITIDAE Gill

Genus VENERICARDIA Lamarck

Subgenus VENERICARDIA s. s.

Venericardia planicosta var. *samanensis* Olsson

Plate 1, fig. 1.

Venericardia planicosta var. *samanensis* Olsson, 1928, *Bulls. Amer. Pal.*, vol. 14, No. 52, p. 28, pl. 5, figs. 4, 5, pl. 6, fig. 6.

This species is refigured from a very perfect specimen collected by Mr. Oscar Haught in the basal Talara beds of Yasila.

Locality and Geologic Occurrence.—Talara formation: Negritos, Lagnitus, Yasila, etc. Saman formation: Lagunitus, Saman, Paita, Bayovar.

Venericardia simillina, n. sp.

Plate 2, fig. 3.

Shell small, thin, subcircular to sub-ovate, moderately convex; in older shells the beaks become more inequilateral and in the type specimen is situated near the anterior $\frac{1}{4}$ th; umbos full, prominent with the greatest convexity of the shell slightly posterior and above the middle of the disk; there is a broad, posterior umbonal angle above which the surface is somewhat depressed or excavated; sculpture consists of about 20, narrow, knife-like, generally tuberculated ribs separated by wider and deeper interspaces; except the first 4 anterior ribs and the 5 posterior ones on the posterior-dorsal slope, the ribs are terraced on each side or stand on a broad, square basal platform above which rises the narrow central rib; the top of the central rib is usually cord-like and finely ornamented with widely spaced, small but elevated beads or tubercles; these beads seem to have been present on all the ribs but are easily destroyed by weathering,

Length 18mm.; height 16mm.; semidiameter 5.5mm.

Remarks.—This species is a member of the group of *V. alticostata* Conrad. According to Harris's figures the nearest approach is found amongst the Claibornian forms, especially the

variety designated *transversa* by Lea. *Alticostata* differs from *simillina* in having a greater number of ribs, the beading is coarser and less distant and in the sculptural details along the sides of the ribs. Associated with the type are several smaller *Venericardia* which may be the young of this species. They are more circular in form and their sculpture is less elegant.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Superfamily LUCINACEA

Family LUCINIDAE Fleming

Genus PHACOIDES Blainville

Subgenus PSEUDOMILTHA Fischer

Phacoides (*Pseudomiltha* ?), sp.

Plate 1, fig. 5.

Shell large, subcircular, subequilateral, moderately convex; umbos low, wide; posterior-dorsal area distinct, depressed and moderately wide; dorsal or hinge-margin straight with the rest of the valve margin forming part of a nearly perfect circle; sculpture of fine, concentric growth-lines; interior concealed.

Height 93mm.; length 91mm.; semidiameter 25mm.

Remarks.—Only a single, much weathered specimen of this large lucinoid is known. Since the interior is concealed so that the presence or absence of hinge teeth is not known, it is referred to *Pseudomiltha* principally on account of its large size. The posterior-dorsal area is deeper and more strongly defined than on most members of this group. It resembles *P. giganteus* Deshayes⁸ of the Parisian Eocene by its subcircular outlines but the umbos are higher and fuller. *P. haitensis* Woodring and Mansfield⁹ from the Plaisance limestones of Haiti is longer, more depressed and with flatter umbos. *P. megameris* Dall¹⁰ from the Yellow limestones of Jamaica is a much larger species reaching a length of 235 millimeters but only known in the form of casts. Trechmann¹¹ in his interesting and valuable paper on the Mollusks of the Yellow limestones of Jamaica records 3

⁸Deshayes 1824, Coq. Fos. env. de Paris, i., p. 91, pl. 15, figs. 11, 12.

⁹Woodring and Mansfield 1924, Appendix 2, Geol. of Republic of Haiti., p. 612, pl. 10, fig. 1. (p. 106).

¹⁰Dall 1901, Nautilus vol. 15; Proc. U. S. Nat. Mus., vol. 23, pl. 42, fig. 1.

¹¹Trechmann 1923, Geol. Mag., vol. 60, pp. 347, 360, 361, pl. 14, fig. 5, pl. 17, fig. 6.

other *Pseudomilthas* which he compares with European species.

Locality and Geologic Occurrence.—Clavilithes series, coastal phase rocks of the Clavilithes series along the base of the Amotape Mountains near Monte Grande, Que. Parinas.

Subgenus MILTHA Adams

Phacoides (Miltha) woodi, n. sp.

Plate 2, figs. 9, 12.

Shell elevated, with the height about equal to the length, rather compressed; beaks small, pointed, curved slightly forward over the minute and almost obsolete lunule; basal margin forming more than $\frac{3}{4}$ ths of a circle in outline, except that the anterior part is straighter; anterior-dorsal area short, and defined by being depressed below the general surface of the disk; posterior-dorsal area wider, defined by a narrow sulcus and with a wide median fold from the beak to the margin and bordered above by a second sulcus; sculpture consists of very fine, concentric lines, interrupted by heavier, resting marks; this sculpture is somewhat coarser on the dorsal margin; hinge with well developed cardinal teeth.

Height 32mm.; length 32.5mm.; semidiameter 2.5mm.

Remarks.—This species is a true *Miltha* belonging to the group exemplified by *P. (M.) childreni* Gray of the Brazilian coast, *P. xantusi* Dall of the Gulf of California and several fossil species. Commencing in the basal Talara beds, this species continues through the Saman into the Chira and Mancora formations. The Saman sandstone specimens in our collection are usually smaller, heavier and slightly more convex than the forms from the basal Talara and Mancora rocks. The Middle Oligocene shells from the Mirador sandstones of the Chira valley are very similar to the typical form from the basal Talara. Other species of *Miltha* in the Peruvian Eocene are *Lucina paytensis* Woods¹² and *Phacoides conventus* Olsson¹³. *L. paytensis* differs in being more quadrate, less circular in form, the ventral margin is straighter and the beaks are lower and less pointed. *Miltha iheringiana* Doella-Jurado¹⁴ from the Enterriene formation of

¹²Woods, 1922, p. 70, pl. 4, figs. 5a, 5b.

¹³Olsson, 1929, Bulls. Amer. Pal., No. 57, p. 9, pl. 3, fig. 3.

¹⁴M. Doello-Jurado, 1919, Physis (Rev. de la Soc. Arg. de Ciencias Naturales), t. 4, pp. 558-562, figure.

Argentine differs principally in being larger.

Locality and Geologic Occurrence.—Mancora formation, Que. Charanal; Saman formation, Casa Saman; Talara formation, Yasila

Subgenus HERE Gabb

Phacoides (Here) andersoni, n. sp.

Plate 2, figs. 5, 6, 7.

Shell small, solid, moderately convex; the shape of the shell is generally subcircular with the beaks slightly anterior of the middle; anterior-dorsal side straight with a very small, sunken lunule; posterior-dorsal area wide, depressed, wing-like and defined by a deep sulcus or groove; sculpture of wide, heavy, rounded, concentric ribs (recalling those of *Lirophora*) and separated by deep, wide grooves; they are usually about 8 in number and continue across the posterior-dorsal submargins to the ventral margin; interior of the shell deep, with the ventral margin appearing smooth or weakly crenulated; hinge with strong cardinal and lateral teeth.

Length 7.75mm.; height 8.25mm.; semidiameter 3mm.

Length 9.25mm.; height 9mm.; semidiameter 3.5mm.

Length 8mm.; height 8mm.; diameter 7mm.

Remarks.—When first collected, this shell was believed to belong to the genus *Volupia* of Defranc. *Volupia* is described as having a large lunule, 3 cardinal teeth and its figure shows a strongly trigonal shell and no differentiated posterior-dorsal submargin. Fischer¹⁵ believed *Volupia* to belong to the *Veneridæ* and placed it near *Anaitis* and the *Chiones*. Dall¹⁶ followed Fischer in placing *Volupia* with the *Veneridæ* as a section of *Chione* but with misgivings that the shell was really a lucinoid and related to *Here*. The lucinoid affinities of *Volupia* was finally fully established by Cossmann and Pissaro with *Gradilucina* Cossmann based on *Lucina tabulata* Defr. of the Parisien Eocene falling as a direct synonym¹⁷.

Anderson's *V. bolivarensis*¹⁸ from the Eocene of Colombia may be a true *Volupia* but it is said to have a small lunule and a

¹⁵Fischer, 1887, Manuel de Conchyliologie, p. 1084.

¹⁶Dall, 1903, Trans. Wagner Free Inst., vol. 3, pt. 6, p. 1288.

¹⁷Cossmann and Pissaro, 1904-06, Icon, complete des Coq. de l'Eocene de Paris, pl. 27, fig. 82-1 and footnote.

¹⁸Anderson, 1928, Proc. Calif. Acad. of Sciences, vol. 17, p. 22, pl. 1, figs. 7, 8.

flange-like projection on the posterior side descending from the shell which suggests a differentiated posterior-dorsal area. The *Lucina dolabra* Conrad¹⁹ from the Claiborne sands of Alabama may be a true *Volupia*. In this shell, the lunule is deep, the posterior-dorsal area is very narrow but defined by a deep groove and the external sculpture consists of coarse, broad, irregular concentric ribs.

Broken specimens of *andersoni* may resemble Anderson's figure of *Volupia bol'varensis* but perfect shells differ by their more circular form, apparently more numerous ribs and stronger posterior-dorsal area.

Locality and Geologic Occurrence.—Talara formation, Yaslia.

Phacoides (Here) nonurensis, n. sp.

Plate 2, fig. 8.

Shell of medium size, coarse, inequilateral, plump; outlines subcircular to subquadrate with the small, pointed beaks near the anterior 1/3rd; posterior-dorsal areas defined by being depressed below the general surface level but not delimited by any evident line or sulcus; lunule large, broadly lanceolate; surface sculpture consists primarily of coarse, elevated, thick concentric ridges between wide, flat interspaces; the ribs on the holotype have an average spacing of 1 1/2 millimeters on the middle of the disk but become much closer and crowded on the dorsal areas; lunule large, lanceolate pouting in the middle, coarsely sculptured by the ends of the concentric ribs; interior concealed.

Height 20mm.; length 20.5mm.; diameter 13.5mm.

Locality and Geologic Occurrence.—Saman formation, Nonura Bay Sechura. Talara formation, Caleta Sal.

Superfamily CARDIACEA

Family CARDIIDAE Fischer

Genus CARDIUM Linné

Cardium junceum, n. sp.

Plate 2, figs. 4, 10.

Shell small, thin, convex, subquadrate to subcircular truncate behind; umbos high, prominent and full with the greatest inflation of the shell about the center of the disk; basal and anterior margin evenly rounded, the posterior straight or slightly curved;

¹⁹Conrad, 1833, Amer. Journ. Sci., vol. 23, p. 343, Harris, 1919, Bulls. Amer. Pal., vol. 6, p. 111, pl. 37, figs. 17-21.

the posterior-umbonal slope is slightly angled or rounded, feebly defining the posterior-dorsal submargins from the rest of the surface; posterior-dorsal submargins flattened to slightly concave; sculpture consists of strong, ornamented ribs and interspaces, strongest on the medial portion of the shell, smaller on sides; the ribs number about 27 with 19 ribs anterior of the umbonal angle; the ribs are square in section, separated by deep, wide, flat interspaces; the summit of the ribs are generally exfoliated but when perfect are ornamented with a line of fairly large, closely spaced beads or tubercles; the flat interspaces and sides of the ribs are scalloped or cross-striated by evenly spaced incised lines; hinge of left valve with 2 cardinal teeth, the anterior one much the larger and 2 deep, lateral sockets.

Height 16.5mm. (imperf.); length 16mm.; semidiameter 6mm.

Height 15mm.; length 14mm.; semidiameter 5.5mm.

Height 18mm.; length 17.5mm.; semidiameter 4.5mm.

Remarks.—From *C. samanicum*, this species differs by its constantly smaller size, thinner shell and more numerous ribs. The *Fragum* or *Trigoniocardium*-like form is not so well developed as in that species.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Superfamily VENERACEA

Family VENERIDAE Leach

Genus PITARIA Römer

Subgenus PITARIA s. s.

Pitaria (Pitaria) yasila, n. sp.

Plate 2, fig. 11.

Shell of medium size, oblong or subquadrate, convex; basal or ventral margin rounded in the anterior portion, becoming nearly straight towards the posterior side; dorsal side arcuate; anterior extremity more narrow, rounded, produced beyond the tip of the beaks which are situated near the anterior $\frac{1}{4}$ th; the shell is moderately convex, greatest about the center with a fairly prominent but rounded posterior-dorsal, umbonal slope; a shallow dorsal-anterior slope is present on the opposite or anterior side of the beaks, between which the umbos or center of the shell disk

appears flattened or slightly impressed; surface smooth, with the growth lines somewhat stronger along the posterior-dorsal edge; anterior adductor muscle scar deep; hinge unknown.

Length 45.5mm.; height 30.5mm.; diameter 23mm. (mold).

Remarks.—In outlines, this species resembles the *Meretrix angelinae* Harris²⁰ from the Eocene of Angelina County, Texas. The Peruvian species is smaller, more convex, with larger and more prominent umbos and shorter, more pointed anterior extremity. Although several specimens are known, they are all poorly preserved with all or only a part of the external shell remaining.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Subgenus LAMELLICONCHA Dall

Pitaria (*Lamelliconcha*) *baldryi*, n. sp.

Plate 2, figs. 1, 2.

Shell small, thin, delicate, ovate-elliptical, inequilateral; umbos high, full with prominent beaks situated near the anterior 1/3rd; lunule small, deeply impressed or excavated, smooth; anterior side below the lunule is evenly rounded; posterior end blunt; ventral margin evenly rounded; posterior-dorsal side straight or slightly arcuate; surface sculpture consists of narrow, thin, elevated and distantly spaced lamellae which on the middle of the shell disk are approximately 2mm. apart, but become much closer near the ventral margin; they are lacking from a narrow zone bordering the posterior-dorsal margin and from the lunule; the flat intespaces are further marked with weak, subobsolete striae; interior of the shell moderately deep; ventral margin smooth.

Length 20.5mm.; height 15.5mm.; semidiameter 4.5mm.

Remarks.—In type of sculpture, this species is nearest *P. parinensis* Olsson but differs by its thinner and more delicate shell, higher umbos and beaks and more pointed posterior extremity. The concentric lamellae are also more delicate and widely spaced.

The species is named for Mr. R. A. Baldry, Geologist of the Lobitos Oilfield, Ltd., at Lobitos.

Locality and Geologic Occurrence.—Talara formation, Yasila.

²⁰Harris, 1919, *Bulls. Amer. Pal.*, vol. 8, p. 17, pl. 2, figs. 12, 13. Palmer, 1927, *Pal. Americana*, vol. 1, no. 5, p. 225, pl. 4, figs. 16, 19.

Class GASTROPODA

Subclass STREPTONEURA

Order CTENOBRANCHIATA

Superfamily TOXOGLOSSA

Family TEREBRIDAE Adams

Genus TEREBRA Bruguière

Subgenus STRIOTEREBRUM Sacco

Terebra (Strioterebrum) negritensis, n. sp.

Plate 5, figs. 5, 8, 16.

Shell small slender, solid, porcellaneous and generally whitish in color; nucleus small of about 2 whorls with submerged tip; subsequent whorls 10, straight or slightly convex with a slow, even taper; sutures linear, close and slightly appressed; body-whorl of medium size and about $1/3$ rd the length of the whole shell; a sutural band present on all except the nuclear whorls bordered below by a weak, broad groove; axial ribs on spire-whorls are quite strong, become low, obsolete and irregular on the later; on the spire-whorls, the sutural band is weakly nodulated by the ends of the ribs, partially disjointed by the sutural groove and then continued as narrow, straight or slightly curved ribs to the lower suture; on the penultimate and last whorl, the ribs below the sutural are quite irregular and often nearly absent; surface generally appears nearly smooth and porcellaneous but close examination of perfect shells show very fine spiral striæ; anterior canal of moderate length, straight; columellar probably smooth, unarmed.

Length 16mm.; diameter 3mm.

Remarks.—All of our specimens have the aperture filled with matrix wholly or partly concealing the columella from view but as far as can be determined the pillar appears to be smooth and unarmed. On most shells the surface is smoothish, porcellaneous and white, with the axial sculpture fading and becoming irregular on the penultimate and body-whorl. When perfectly preserved however, the entire surface on magnification is seen to be covered with fine spiral threads.

Another *Strioterebrum* is found at Yasila. It is a small, sub-

ulate species with a persistent sutural band defined by a deep, spiral groove. It is sculptured with numerous, narrow and equal axial riblets and persistent spiral threads. The specimens are however too poorly preserved for naming and further characterization.

Locality and Geologic Occurrence.—Talara formation, Salina near Negritos, Yasila.

Family CANCELLARIIDAE Adams

Genus ADMETE Kroyer

Subgenus ADMETE Kroyer

Section BONELLITIA Jousseau

***Admete (Bonellitia) paytensis*, n. sp.**

Plate 11, fig. 5.

Shell small, delicate, high-spined; protoconch small, smooth, eroded; subsequent whorls about 4, strongly convex between deep and slightly grooved sutures; last whorl large, moderately convex near or just above the middle with a sloping base ending in a pointed anterior canal, narrowly umbilicate; sculpture strongly reticulate on the spire-whorls with 5 or 6 spiral cords and nearly equal, small longitudinal riblets; on the last whorl of mature shells, the spirals are generally stronger than the riblets and alternate in strength; varices or hump-like shoulders occur on the last whorl approximately 180 degrees apart; aperture sub-trigonal with the outer lip internally crenate; columella with 2 strong plications.

Height 15mm.; diameter 10mm.; aperture 10mm.

Remarks.—This species resembles *Admete luffa* Olsson from the Restin of Jabonillal but has a finer and more irregular sculpture.

Location and Geologic Occurrence.—Talara formation, Yasila.

Family TURRIDAE

Genus EOPLEUROTOMA Cossmann

***Eopleurotoma paytensis*, n. sp.**

Plate 3, figs. 11, 16, 17.

Shell small or medium size with the spire much longer than

the aperture; nucleus small, bulinoid of 3 smooth whorls; post-nuclear whorls 6 or 7 forming a rather long, moderately tapering spire; spire whorls straight to slightly convex in profile between straight linear sutures; fasciole feeble bordered above and next to the suture by a heavy, keel-like cord; sculpture of ribs and spirals, the ribs generally disappearing from the last whorl and only the spirals remaining; the ribs number about 11 to a turn, they are low and extend from the fasciole to the lower suture; spiral sculpture consists of closely spaced, even spiral cords which on the spire whorls number 8 or 9 and 21 or 22 on the last whorl; anal sinus is *Turris*-like, deep, broad and situated just below the feeble anal fasciole; aperture short, subelliptical with a short, stubby anterior canal; inner lip smooth or armed internally with several long, irregular liræ.

Length 16mm.; diameter 4.50mm.; aperture 5.75mm.

Remarks.—*Eopleurotoma* cf. *bicatena* Lam. has been recorder by Trechmann²¹ from the Scotland beds of Barbados.

Locality and Geologic Occurrence.—Talara formation, Yasila.

***Eopleurotoma wiedeyi*, n. sp.**

Plate 4, figs. 5, 10, 11.

Shell much resembling *paytensis* but larger with a more contracted body-whorl and longer anterior canal; whorls 9 with a feeble, anal fasciole situated near the middle of the upper half of the spire-whorls so that their profile appears to be slightly concave; above the fasciole, the suture is bordered by a ribbon-like fold; sculpture consists of 8 low ribs on the middle of each whorl, lacking from the base of the body-whorl; the whole surface is crossed by spiral threads; on the last whorl, the primary spirals number about 24, with 16 from the shoulder to the tip of the anterior canal; they are fairly widely spaced, with 3 or 4 very fine spirals in the interspaces; growth-lines closely crowded, forming a finely cancellated submicroscopic sculpture; anal sinus wide, situated as in *Turris* on the middle of the whorl; anterior canal of moderate length, slightly curved.

Length 21mm.; diameter 6mm.; aperture 9mm.

Remarks.—This species may be mistaken for the young of *Crassispira woodringi* but the ribbing is quite different. It is

²¹Trechmann 1925, Geol. Mag., vol. 62, p. 497, pl. 24, f. 24.

named for Dr. Lionel Wiedley of the Geological Department at Negritos.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus **HEMIPLEUROTOMA** Cossman

Hemipleurotoma arenosa, n. sp.

Plate 3, figs. 4, 5, 6.

Shell small, fusiform with the spire more than twice the length of the aperture; nucleus very small, eroded; subsequent whorls 6 or 7, convex or shouldered about the middle with a concave or constricted zone on each side of the suture; fasciole broad, concave or sloping, bordered next to the suture by a spiral cord which is much heavier on the earlier whorls; last whorls larger and more convex with a short, slender, pointed anterior canal; shoulder of whorls with numerous, low, bead-like ribs lacking from the rest of the shell; these ribs are strongest on the spire-whorls and may become absent or obsolete on the body-whorl; the surface is further sculptured by fine and coarse spiral threads arranged as follows: a sutural cord already mentioned, generally 1 or 2 primary spirals on the shoulder crossing the bead-like ribs, a set of 3 or more irregular primary threads on the middle and base of body-whorl passing into closely spaced but smaller threads on the anterior canal, fine secondaries in the fasciole and on the interspaces between the larger spirals; aperture subelliptical with a short but slender anterior canal; anal sinus deep, situated *Turris*-fashion on the shoulder.

Length 17mm.; diameter 6.25mm.; aperture 7.5mm.

Length 19.25mm.; diameter 7mm.; aperture 8mm.

Remarks.—This shell is probably correctly referred to Cossman's genus *Hemipleurotoma*. Cossmann at first considered *Pl. archimedis* Bell. as genotype, later changing to *Pl. denticula* Bast. Several species of *Hemipleurotoma* grouped about *Pl. childreni* Lea occur in the Claiborne sands.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus **MONILIOPSIS** Conrad

Moniliopsis peruviana, n. sp.

Plate 3, figs. 7, 12, 18, 19.

Shell small or medium size, with a long, slender spire and

shorter aperture; whorls 8 or more, those of the spire straight to slightly convex so that the profile of the spire is nearly straight; sutures straight, slightly excavated; sutural fasciole absent or very feeble; body whorl not quite half the length of the shell and generally somewhat more convex than the spire whorls; aperture subelliptical with a straight, stout, stubby anterior canal; the inner lip is somewhat callused and usually with a narrow umbilical chink at the tip of the anterior canal; sculpture consists principally of coarse, closely spaced, regular spirals separated by deep grooves; the spirals number 9 on the spire whorls and 19 or 20 on the last whorl; the earliest spire-whorls have a few low ribs but most of them have only a spiral sculpturing; anal sinus is *Turris*-like, deep, wide and situated on the middle of the whorls; outer lip with long, narrow, internal liræ.

Length 21mm.; diameter 5.5mm.; aperture 7.25mm.

Remarks.—*Pleurotoma elaborata* Conrad²² the type of the genus *Moniliopsis*²³ is a beautiful *Scobinella*-like shell but with a straight, smooth pillar. The sculpture consists principally of coarse, rope-like spiral cords, but which can hardly be called cancellate as described by Conrad. The present species although not agreeing entirely with *Moniliopsis* is nearest that genus in general form and type of sculpturing. Dall has described several species of *Pleurotomoids* from the recent Pacific fauna which he refers to *Moniliopsis*.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Moniliopsis ? paytensis, n. sp.

Plate 3, figs. 8, 14, 15.

Shell small, slender with a long, tapering, acute spire and relatively short, sub-elliptical aperture; nucleus eroded, very small; subsequent whorls 9, sculptured with strong, acute spiral cords separated by deep, concave interspaces; sutures close, indistinct; the sculpture is *Mitra*-like consisting of sharp, elevated, spiral threads between wide, deep, concave interspaces; the spirals number about 3 on the spire-whorls, 6 on the middle and base of last whorl; on the anterior canal, the spirals are more irregular and crowded; the grooved interspaces may have one or more secondary threads and further sculptured with close-set, raised threads parallel to the growth-lines; aperture subelliptical with a short anterior canal; pillar straight smooth; anal sinus when

²²Conrad 1832, *Foss. Shells Tert. Form.*, 1, p. 52, pl. 17, fig. 19.

²³Conrad 1865, *Amer. Journ. Conch.*, vol. 1, p. 143.

discernible is situated *Turris*-like on the shoulder or just above the middle of the whorl; inner lip moderately heavy and often bearing one or more internal liræ.

Length 18mm.; (imperf.); diameter 5mm.; aperture 5mm.

Length 14.5mm.; diameter 4mm.; aperture 5mm.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus CRASSISPIRA Swainson

Crassispira woodringi, n. sp.

Plate 3, fig. 1.

Shell of medium size, solid; whorls about 9; nucleus absent; spire whorls slightly convex between close, indistinct sutures with a sloping, broad but scarcely constricted anal fasciole and in which the anal sinus lies in the lower half and just above the shoulder of the whorl; the whorls are feebly shouldered, this shoulder bearing on the last turn about 8 low, knob-like ribs which become nearly obsolete on the back of the body-whorl; the ribs are absent from the fasciolar band; the spiral sculpture is quite weak and consists of primary, secondary and tertiary threads; the spirals of primary strength consists of a single thread a short distance below the upper suture, 2 or 3 threads on the spire whorl between the shoulder and the lower suture and 15 or more on the last whorl between the shoulder and the tip of the canal; the primary spirals are subregular in size and spacing with fairly wide interspaces; secondary threads occur mainly in the fasciolar area and are irregular in size and spacing; the whole surface is further overrun by very fine secondaries; growth lines strong, crowded on the last whorl; the anal sinus is deep, narrow and situated just above the shoulder angle; anterior canal moderately long, strongly twisted, often developing a pronounced fold at the tip.

Length 30mm.; diameter 9.5mm.; aperture 13mm.

Length 34mm.; diameter 9mm.; aperture 13.5mm.

Remarks.—The anterior canal is moderately long, stout and strongly twisted near the tip but shorter than in the forms generally grouped near or with *Turricula*. The anal fasciole is sloping, scarcely constricted, with the deep anal sinus situated just above the shoulder and some distance below the upper suture. It is more slender than typical *Crassispira*. It is possibly

distantly related to *Turris* (*Surcula*) *resina* Dall²⁴ recent in the Gulf of Panama and to Woodring's²⁵ *Crassispira aegis* from Bowden.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Crassispira capella, n. sp.

Plate 4, figs. 3, 4.

Shell small or medium size, solid, biconic with the spire somewhat longer than the aperture and anterior canal; nucleus (eroded) small, pointed, followed by 7 or 8 subsequent whorls; sutures close, indistinct, bordered by a cord or keel between it and the fasciole; fasciole wide and concave, but not sharply delimited from the rest of the shell surface; the fasciole occupies nearly $2/3$ of the surface of each spire-whorl; sculpture consists of heavy, distant ribs and spirals; the ribs number about 6 on the last whorl; they are strong and knob-like on the lower half of each spire-whorl; the spiral sculpture consists of strong, raised primary cords on the lower half of each spire whorl or below the fasciole; the spirals overrun the top of the axial ribs; on the last whorl there are 6 or 7 threads on the middle and base with 12 or more on the anterior canal; secondaries and fine spiral threadlets occur in the wide interspaces between the primaries and over the fasciole; growth-lines closely crowded, with the anal sinus lying in the center of the sutural fasciole; anterior canal of moderate length, stout, straight.

Length 20mm.; diameter 6.5mm.; aperture 9mm.

Remarks.—This species seems correctly referred to *Crassispira* as that genus is commonly used at present. It resembles Dall's figure²⁶ of *Crassispira bacchia* of the recent Lower Californian fauna.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus TURRICULA Schumacher

Subgenus PLEUROFUSIA Gregorio

Turricula (*Pleurofusua*) *colavinia*, n. sp.

Plate 3, figs. 2, 9, 10.

Shell small, moderately slender and coarsely sculptured; nuc-

²⁴Dall 1908, Bull. Mus. Comp. Zool., vol. 43, no. 6, p. 264, also Dall 1919, Proc. U. S. Nat. Mus., vol. 56, p. 16, pl. 2, fig. 4.

²⁵Woodring 1928, Constr. to the Geology and Paleontology of the West Indies, Carnegie Institution of Washington, No. 385, p. 151, pl. 4, fig. 12.

²⁶Dall 1919, Proc. U. S. Nat. Mus., vol. 56, p. 25, pl. 6, fig. 1.

leus small pointed; post-nuclear whorls about 8 or 9 according to the size and maturity of the shell, sculptured with low ribs and coarse spirals; upper half of the spire-whorls deeply constricted to form the anal fasciole which is nearly smooth except for very fine, submicroscopic threadlets and usually a single, large spiral thread just below the suture; the longitudinal or axial sculpture is formed on the spire-whorls by 4 or 5, low ribs which occur only on the middle of the whorls and are lacking from the anal fasciole; on the last whorl they generally become irregular or subobsolete and do not extend far below the shoulder; the spiral sculpture is uniformly coarse and harsh; on the spire-whorls there are generally 4 threads between the anal fasciole and the lower suture, increasing to 15 or 16 on the body-whorl; they are spaced subregularly between much wider, band-like interspaces; on the center of the whorl, the interspaces have a central, larger secondary thread, or a variable number of much smaller tertiary threads; anterior canal long and very slender.

Length 29mm.; diameter 9.5mm.; aperture 13mm.

Remarks.—Along with several other groups which begin in the basal Talara beds, this species is the first of a phylogenetic series with representative species in the Oligocene, Miocene and recent faunas. In the Peruvian Oligocene, this group is represented by a new species, *Turricula piura*. The Miocene species include the *Turricula lavinoides* Olsson from Costa Rica, and *Turricula jacquensis* Sowerby from Santa Domingo. The recent species is *Turricula lavinia* Dall from the West Coast of Mexico.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus FUSITURRICULA Woodring

Fusiturrlicula yasila, n. sp.

Plate 3, fig. 3.

Shell small, slender, the spire somewhat longer than the aperture and anterior canal; whorls 8 or 9, the first 2 or 3 nuclear whorls appearing to be smooth while the others are sculptured with fairly large, distant ribs crossed by fine spiral threads; the ribs number 5 to each turn; they are nearly in line on adjacent whorls except on the spire where they may be irregularly spaced; on the last whorl, the ribs are quite heavy on the upper and middle portion of the whorl but lacking from the anterior canal; the

sutural area is constricted and ornamented with a strong sutural cord; fine spiral threads overrun the whole surface of the shell, the summit of the ribs and their interspaces; anal sinus deep, lying in the sutural fasciole; anterior canal fusoid, long, slender and straight; pillar or columella straight.

Length 21mm. (imperf.); diameter 6.50mm.

Length 20.5mm.; diameter 7.50mm.

Remarks.—This is a *Fusus*-like species and small shells not showing the anal sinus might easily be mistaken for members of the *Fusidae*. The anterior canal is long, slender and nearly straight. Sculpture consists of heavy but not prominent, distant ribs which are lacking from the smoothish sutural fasciole and from the base of the last whorl.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus GENOTIA, H. and A. Adams

Genotia peruviana, n. sp.,

Plate 4, figs. 1, 2.

Shell small to medium size, thin with strongly coronated whorls and high scalar spire; nucleus rather large of 3 convex turns, the first quite small, the other 2 large and nearly equal in size; post-nuclear whorls 3 or 4, strongly shouldered about the upper $1/3$ rd, this shoulder angle bearing a series of weak knobs or tubercles, sometimes without; above, the shoulder is flat, sloping or barely concave, while below the sides of the whorl is straight to the lower suture; sutures distinct bordered on the anterior side by a simple or beaded spiral; last whorl large, slowly contracting to the anterior tip; sculpture of moderately strong, regular spirals covering the whole shell but sometimes more crowded on the shoulder angle which also may have faint knobs or tubercles; posterior sinus wide, the center lying along the shoulder angle; inner lip crenulated.

Height 14.5mm.; diameter 6mm.; Yasila

18mm. (broken tip and canal, 3 whorls) diameter 9.5mm
22mm. (estimated length)

18mm. (4 whorls, broken tip and canal); diameter
8.5mm.

20mm. (estimated length)

Remarks.—This species although well represented in our collection by numerous specimens, is usually poorly preserved and it has been necessary to select for the Holotype, a small but nearly perfect specimen from Yasila. The protoconch as described above, is fairly large and composed of 3 or 4 convex, smooth whorls.

In the basal Talara beds, our largest specimen has a length of about 17mm. The Oligocene specimens are larger and heavier and represent shells which may have reached a length of 25mm. or more when perfect. These later shells do not differ in any important degree from the Eocene examples.

The genus *Genotia* has not been generally recognized in the American Tertiaries, but probably several species will be separated after a critical study of the described forms of *Turridae*. The *Conus pulcherrimus* Heilprin²⁷, as may be seen by the excellent figure of Aldrich²⁸ belongs to this genus. Fossil species of *Genotia* are well-known in the European and Indian Tertiaries and the living species *mitraeformis* Kiener is found along the west coast of Africa.

Genotia peruviana resembles Cossmann's²⁹ figure of *Clathurella Milleti* (Desm.), from the Miocene of Peloua but the sinus is *Turris*-like or situated on the shoulder. They also resemble the *Genotia pulcherrima* Heilprin already referred to and *Genotia birmanica* Vredenburg³⁰ from the Miocene of India.

Genus SCOBINELLA Conrad

Subgenus MITRATOMA, n. subg.

Type. *Scobinella* (*Mitratoma*) *bartschi*, n. sp.

The following is a description of the subgenus *Mitratoma*.

Shell small or medium-sized, *Mitra*-like but with a shorter anterior canal and a deep sutural fasciole; nucleus unknown; spire about 1.5 times the length of the aperture; the anal fasciole is quite deep, bordered above by a strong, sutural cord and below by the angled shoulder of the whorl; sculpture is *Mitra*-like consisting principally of deep, spiral grooves forming broad, flat

²⁷Heilprin, 1879, Proc. Acad. Nat. Sci. Phila., p. 213, pl. 13, fig. 8.

²⁸Aldrich, 1897, Bulls. Amer. Pal., vol. 2, p. 173, pl. 5, fig. 7.

²⁹Cossmann, 1896, Pal. comp., vol. 2, pl. 6, figs. 36, 37.

³⁰Vredenburg, 1922, Records Geol. Sur. of India, vol. 53, p. 132, pl. 15, figs. 4, 5.

spiral bands; shoulder or anterior side of anal fasciole feebly ribbed or noded; anal sinus small, lying in the center of the sutural fasciole; columella straight provided with 4 *Scobinella* or *Mitra*-like, low folds; outer lip strongly lirated within.

Remarks.—*Mitratoma* is obviously related to *Scobinella* of Conrad but differs by its still more *Mitra*-like form and sculpture. In *Scobinella*, the whole surface including the fasciole is covered with close and beautifully beaded spiral cords. Both have the interior of the outer lip strongly lirated.

Scobinella (Mitratoma) bartshi, n. sp.

Plate 4, figs. 6, 7, 8, 9.

Shell small or medium-size, *Mitra*-form, stout; nucleus small, pointed but not well-preserved on any of our specimens; post-nuclear whorls 7 or more, forming an evenly tapering spire about 1.5 times the length of the aperture; sutural fasciole pronounced deep and occupying slightly more than $1/3$ rd the width of the spire-whorls; it is bordered on the posterior side by a strong sutural cord and on the anterior side by a sharply angled shoulder; the spire-whorls have the shoulder sharply noded by strong, oblique riblets which usually fade out on the penultimate and last whorl; the more pronounced sculpture of the body-whorl is strong spiral bands, very wide in the middle and next to the shoulder, narrower and more cord-like on the anterior canal; anterior canal stout, short; columella straight with 3 or 4 *Scobinella*-like folds, stronger above; interior of outer lip strongly and closely lirated.

Height 16.25mm.; diameter 5.5mm.; aperture 7mm.

Remarks.—The appearance of this species is strongly *Mitra*-like and its pleurotomoid affinities would be doubted, were it not for its deep, pronounced sutural fasciole and small but typical anal sinus. The columella is provided with 3, 4 or more *Scobinella*-like folds which become lower and weaker towards the anterior side. It is quite common in the Lower Talara shales of Yasila.

Locality and Geologic Occurrence.—Talara formation, Yasila.

³¹Conrad 1848, Journ. Acad. Nat. Sci. Phila., ser. 2, vol. 1, p. 120.

Family CONIDAE Adams

Genus CONUS Linné

Conus chiraensis, n. sp.

Plate 5, figs. 1, 2, 4, 10.

Shell small or medium-size; in proportions the height approximately twice the diameter; the spire is flat to slightly elevated or conic; shells with a flat spire, have a higher, projecting tip, formed of the nuclear and early post-nuclear-whorls; in the higher spired forms, the outline of the spire is low, conic with a higher, projecting nuclear tip; sides of last whorl straight; shoulder of the body-whorl is sharply angled, below which the upper face of the whorl is usually feebly rounded or beveled; post-nuclear whorls about 8, with concave spire faces, lying between the high, ridge-like, peripheral edge of the whorl and the inner sutures; this concave zone sculptured with about 4 low, broad spirals and finer transverse (radial) lines; surface of the whorl below the shoulder is smooth, polished except for growth lines and feeble, irregular spirals on the anterior canal, the growth lines are straight below, curving above to the right and deeply retracted at the shoulder; anterior canal with 12 or more feeble, irregular spiral threads; aperture long, narrow.

Height 39mm. (broken); diameter 31mm.

45mm.; 28mm.

32mm. (broken); 20mm.

Remarks.—The distinguishing characteristics of this Cone are the straight smooth sides, feebly sculptured with revolving spirals about the anterior canal; the spirally-sculptured spire whorls; and strongly retracted growth lines at the sharp shoulder angle. The flat spired shells illustrated by figure 2 is selected as the typical form. This is the dominant form in the older beds first appearing in the basal Talara of Yasila and Cunas de Jaquay near Paíta. The higher spired form illustrated by figure 1 is the common Oligocene variety, but all gradations occur between it and the flat-spired form.

This species resembles the *Conus planiceps* Heilprin from the Tampa Siliceous beds of Florida as figured by Dall³² and the two species have probably a common ancestor. The *Conus sauridens* Conrad from the Jackson Eocene and *C. alveatus* Conrad from Vicksburg belong to the same group, but both species have the spire-whorls more concave.

Locality and Geologic Occurrence.—Talara formation, Yasila and Jaquay de Cunas. Saman formation, Lagunitas, Casa Saman. Chira formation, near Casa Saman, Quercotilla. Mancora formation, Que. Charanal.

Conus peruvianus, n. sp.

Plate 5, figs. 13, 14, 15.

Shell small with moderately high spire, straight sides and generally noded shoulder angle; whorls 8 or more, forming a moderately high, conic spire whose height is approximately $\frac{1}{4}$ th the full length; sutures close, distinct, situated slightly below the edge of the spire-whorls; the upper surface of the spire-whorls is flat to slightly concave, sculptured simply by the strongly curved growth-lines; the shoulder of the last whorl is strongly angled smooth or noded; the spire-whorls are coarsely noded, just above the lower suture, there being on an average about 16 nodes to a volution of a later turn; upper $\frac{2}{3}$ rds of the surface of last whorl smooth, with 8 or 9 wide spiral bands on the anterior canal.

Height 21mm.; diameter 9.5mm.; aperture 15mm.

Remarks.—The noding of the shoulder angle is a variable feature some shells remaining coarsely noded throughout life while in others the shoulder angle becomes sharp and smooth on the later turns. There are several small, noded Cones which distantly resemble *peruvianus*, *Conus remondi* Gabb from the Tejon Eocene of California, according to Stewart's³³ figure is a smaller species with more numerous (22) shoulder nodes. *Conus parvus* Lea from the Claiborne sands differs in having the upper surface of the spire-whorls finely spirally sculptured. In the Parisian Eocene, *peruvianus* finds its closest parallel with *Conus parisiensis* Desh.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Superfamily RACHIGLOSSA

Family OLIVIDAE d'Orbigny

Genus OLIVA Martyn

Subgenus OLIVA, s. s.

Oliva misti, n. sp.,

Plate 6, figs. 2, 6, 8, 11, 12.

Shell small, stout; nucleus pointed; subsequent whorls 5 or 6,

³²Dall, 1915, Bull. 90, U. S. Nat. Museum, p. 37, pl. 61, figs. 1, 2.

³³Stewart 1926, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 414, pl. 29, fig. 15.

forming a medium-height, pointed conic spire; sutures grooved or channelled; last whorl large about $5/6$ th the full length of the shell, medium convex, its greatest inflation opposite the posterior end of the aperture; aperture linear, widest below but not emarginate; columella straight, flat, covered by a callused band merging above with the parietal callus and extending to the posterior end of the aperture; this band of callus is finely lirated nearly its full length (except for a short distance at its posterior end); the anterior end of the callus band is somewhat wider and heavier, and bearing a very weak, internal fold separated by a groove from the lirations above; this fold is but little stronger than the columellar lirations; the anterior external side of callus band is separated from the body-whorl by a deep groove so that its edges appear shelf-like or ribbed; outer lip thin, straight.

Length 18mm.; diameter 7.5mm.; aperture 11mm.

Length 17.5mm.; diameter 7.25mm.; aperture 10.25mm.

Length 17.25mm.; diameter 6.50mm.; aperture 10.50mm.

Remarks.—This species is represented by a large number of specimens from Yasila. Because of its small size and relatively long, sharp spire, it would at first be classed as an *Olivella*. The inner lip and columellar side are straight and finely transversely lirated throughout most of its length as in the true *Olivas*. The anterior part of the columellar callus is somewhat wider, encircling the tip of the base on the anterior side of the siphonal fasciole. The most anterior plait may continue across this band as a very faint, external fold.

The genus *Oliva*, although so abundant in the later Tertiary and recent faunas, has not heretofore been recorded from rocks older than the Miocene. This species although small, seems to be quite typical except that the anterior lirations are not quite so strong as in most *Olivas*.

Locality and Geologic Occurrence.—Talara formation, Yasila, Talara shales of Caleta Sal.

Genus ANCILLA Lamarck

Subgenus ANCILLARINA Bellardi

Ancilla (Ancillarina) pananga, n. sp.

Plate 6, fig. 9, 10.

Shell small or medium size, cylindrical with a spire of moder-

ate length; aperture about $\frac{3}{4}$ ths the length of the whole shell; whorls about 4, those of the spire nearly straight or slightly convex in profile; sutures distinct but usually with a thin wash of callus on the anterior side but spreading across the suture between the last and penultimate whorls; body-whorl large, cylindrical, widest about the middle; aperture long, gradually narrowing above, wider below and obliquely truncate; surface smoothish but under a lens showing fine spiral striations; columellar area mostly concealed with the anterior portion bearing 2 or 3, oblique plaits.

Height 21mm.; greater diameter 7mm.

Remarks.—This species is related to the common *A. canalifera* Lamarck of the Parisian Eocene. In the French species, the spire is generally scalar with shouldered whorls formed by the upper edge of the wider, thicker callus band. The spire and penultimate whorls are longer in the Peruvian shell and hence the aperture is shorter and less effuse.

Cossmann³⁴ placed *A. canalifera* in the subgenus *Tortoliva* of Conrad³⁵ with *Ancillarina* Bellardi³⁶ as synonym. Conrad's³⁷ figure of *O. texana*, the type of *Tortoliva* is very poor and depicts a small, broken and probably immature shell. It appears probable that *texana* is nothing more than a young, worn shell of the common *A. staminea* which would make *Tortoliva* a strict synonym of Conrad's earlier *Olivula*. Tryon³⁸ placed *Tortoliva* as a synonym of *Agaronia* Gray. Professor Harris tells me that the type of *texana* which should be in the Academies collection at Philadelphia is apparently lost or misplaced. Since so much uncertainty exists regarding the status of *Tortoliva* it seems wisest to use Bellardi's subgenus *Ancillarina* the type of which is *A. suturalis* Bon., a Lower and Middle Miocene species of France and the Italian Piedmonte. Five European species are listed by Cossmann from the Eocene, Oligocene and Miocene terranes.

Locality and Geologic Occurrence.—Talara formation, Yasila. Salinas near Negritos.

³⁴Cossmann 1899, *Essais de Pal. comp.*, vol. 3, p. 67.

³⁵Conrad 1865, *Amer. Journ. Conch.*, vol. 1, p. 22.

³⁶Bellardi 1882, *Memoria delle Scienze di Torino*, vol. 34, p. 419, 433.

³⁷Conrad, 1865, *idem*, p. 143.

³⁸Tryon, 1883, *Manual of Conch.*, vol. 5, p. 60.

Genus OLIVANCILLARIA d'Orbigny

Subgenus AGARONIA Gray

Olivancillaria (Agaronia) inca, n. sp.

Plate 6, fig. 5.

Shell of medium size, solid; spire elevated, pointed, the penultimate and spire-whorls together about $\frac{1}{4}$ th the length of the shell; sutures slightly grooved; body-whorl narrow elliptical, its greatest convexity just above the middle; aperture elongate, pointed at the posterior end, broader anteriorly, subemarginate and obliquely truncate; columella straight with a thin, parietal callus above passing into a heavier callus and on the anterior half with 5 or 6, strongly oblique plaits.

Length 25mm.; diameter 10mm.; aperture 17mm.

Length 30mm.; diameter 13mm.; aperture 19mm.

Remarks.—The *O. peruviana* Woods from the Lagunitas sandstones I have not seen. It differs according to Woods figure by its smaller size, broader more stubby spire and by its wider shell. *O. saxosa* Olsson is a much larger, more slender shell with deeply grooved sutures.

Locality and Geologic Occurrence.—Talara formation, Lomitos conglomerate near Negritos, Yasila. Saman formation, Casa Saman.

Family MITRIDAE

Genus MITRA Martyn

Subgenus TIARA Swainson

Mitra (Tiara) yasila, n. sp.

Plate 10, figs. 1, 2.

Shell small to medium size with spire and anterior canal of nearly equal length; whorls 8 or more, with straight or slightly convex profile; body-whorl fairly large and forming about $\frac{2}{3}$ rds of the whole shell; sculpture of low, slightly elevated spiral cords or ribbons, separated by deep, irregular grooves; on the spire whorls there are usually 4 or 5 spiral cords increasing to 22 or more on the last whorl and anterior canal; aperture subelliptical; anterior canal slightly twisted or curved; columella provided with 3 folds of which the upper 2 are much larger than the lower.

Length 25mm.; diameter 8.25mm.; aperture 13mm.

Length 19mm.; diameter 6.75mm.; aperture 11.5mm.

Length 37mm. (imperf.).

Remarks.—In form and sculpture, this species resembles the *Mitra Almagrensis* var. *coralliophilla* Olsson of the Costa Rican Miocene. The Peruvian species is larger with the spire and anterior canal of more nearly equal length.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Family VOLUTIDAE Gray

Genus VOLUTA Linné

***Voluta paytanica*, n. sp.**

Plate 6, figs. 1, 4.

Shell of medium size, solid, pyriform; spire rather low, elevated with the penultimate and last whorl strongly shouldered; nucleus as in *Voluta musica* is bulbous and fairly large, composed of 4 convex, smooth whorls; post-nuclear whorls 2 or more, rapidly increasing in size and becoming strongly shouldered about the upper third; this shoulder is armed with stout, pointed or spine-like ribs which number 9 or 10 on the last turn; the ribs extend but a short distance anteriorly across the face of the whorl and barely discernible from the shoulder across to the upper suture; spaces between the ribs are much wider; in addition the shoulder or sutural area is marked with numerous deep or radial cuts or grooves with narrow ridges between; there are generally 3 such ridges to each major rib and to each interspace; the secondary ridges end at the point of the ribs but extend a short distance below the ribs on the adjoining interspaces; general texture of shell is heavy, porcelaneous; aperture and columellar area unknown.

Height 31mm.; greater diameter 21mm.; aperture 20mm.

Remarks.—The only specimen of this species is a fragmentary shell from which the last whorl has been broken away for nearly a half turn. This condition is indicated by a heavy callus deposit of the inner lip which effectually conceals most of the surface sculpture. The anterior canal is rather short and encircled near the base by 3 ribs, the central one being narrow and keel-like. The nucleus or protoconch is well preserved. It is large, bulbous, composed of 4, smooth convex whorls. It agrees closely with Dall's³⁹ figure of the nucleus of *Voluta musica*.

³⁹Dall 1890, Trans, Wagner Free Institute, vol. 3, pt. 1, p. 77, pl. 6, fig. 8.

Until more perfect specimens are available, showing the features of the columellar region, this species is tentatively referred to the genus *Voluta*.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus PLEJONA Bolton

Subgenus VOLUTOCORBIS Dall

Plejona (Volutocorbis) sula, n. sp.

Plate 11, figs. 6, 13.

Shell small, subfusiform or biconic with the spire and anterior canal of about equal length; whorls 5 or more (nucleus destroyed on our specimens); spire of moderate length, pointed, with the spire-whorls slightly convex between distinct and slightly channelled sutures; body-whorl moderately inflated, widest about the upper one-third and sub-elliptical in general profile; sculpture subreticulate but with the spiral cords predominating over the axial ribs; on the spire-whorls there are 13 or 14 narrow ribs; on the penultimate whorls they are crossed by 4 strong, equal spiral cords and 2 smaller ones in the lower suture; on the last whorl of the type specimen, the axial ribs become larger and more irregular; on still larger specimens, the ribs may become obsolete and disappear; the spiral cords increase to 20 on the last whorl; aperture subelliptical with a thickened outer lip crenulated a short distance back from the edge by 12 or 13, narrow denticles or liræ; columella or pillar somewhat excavated in the middle and bearing 3, oblique, revolving plaits; siphonal sinus or canal shallow.

Length 16mm.; diameter 8.5mm.; aperture 11mm.; (Holotype) 23.5mm.

29mm. (2 whorls); 15mm.

Remarks.—Most of our specimens are broken or crushed and it has been necessary to select a small example as the holotype having a length of about 16mm., but the average size of the species seems to be between 22 to 24mm. There are also 2 large, immature specimens which may belong to a related species. Their sculpture is less harsh, ribs obsolete and the spiral cords are more irregular in strength. *V. sula* resembles *V. limopsis* Conrad⁴⁰ of the Midway Eocene and type of Dall's subgenus *Volutocorbis*

⁴⁰Harris, 1896, *Bulls. Amer. Pal.*, col. 1, p. 198, pl. 8, fig. 3.

but has a higher and more pointed spire, coarser and less tubercular sculpture. A striking feature of the species, is the thickened, crenulated outer lip.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus **LYRIA** Gray

Lyria busera, n. sp.

Plate 8, figs. 3, 5.

Shell of medium size, solid with coronated or shouldered whorls; whorls 4 or more (the tip of the spire with the protoconch missing), solid, coronated with 8 or 9, fairly strong ribs or knobs; these ribs are strong and persistent on the spire whorls and cross from suture to suture; they become irregular and obsolete on the lower half of the body whorl and on large shells the lower part of this whorl may be smooth; the surface is smooth, porcelaneous and aside from the ribs, sculptured simply with crowded growth lines; anterior canal slightly twisted with a deep, siphonal sinus at its tip; aperture destroyed in our specimens; columella straight with 5 plaits or liræ.

Length 33mm.; diameter 19mm.; (4 whorls)

35mm.; 23mm.

Remarks.—The type specimens of this species come from the Restin shales north of Negritos. We have also a single crushed shell from the lower Talara shales of Yasila. The species resembles *Lyria turgidula* Deshayes of the Parisien Eocene but has less numerous and less persistent ribs. It also resembles the *Voluta quinqueplicata* Bayan of the Lutetien of Beynes.

In typical *Lyria* as exemplified by its genotype *Lyria nucleus* Lamarck there are but 3 plicæ situated on the columella of the very short anterior canal. The parietal callus is thin or lacking and the outer lip is not greatly thickened. Most of the fossil species credited to *Lyria* differ by having a greater number of plaits which continue upward across the heavier parietal callus. *Lyria lyriformis* Broderip recent of Australia agrees in these characters best with the fossil forms. The parietal callus is heavy and besides the 2 strong folds on the columella there are 12 or more, smaller, regular plaits along the parietal wall. The outer lip is thickened or rib-like. The protoconch of *lyriformis* is large while it is very small in *nucleus*.

Locality and Geologic Occurrence.—Restin formation, north of Negritos; Talara formation, Salina near Negritos, Yasila.

Family XANCIDAE

Genus XANCUS ("Bolten") Roeding

Subgenus EOXANCUS, n. subg.

The following is a description of the Subgenus *Eoxancus*.

Type *Xancus* (*Eoxancus*) *talarensis*, n. sp.

Shell of medium size, subfusiform, solid; spire high of moderate taper, equalled or slightly exceeded by the anterior canal; nucleus unknown; early post-nuclear whorls strongly sculptured with ribs and spirals, this sculpture becoming obsolete leaving the last 3 turns smooth; sutures canaliculate or channeled; last whorl not contracted about the base; anterior canal, long, with an even taper, pointed at its tip and with a slight fold or bulge about the middle; columella with 2 sharp, keel-like folds.

Remarks.—This group is evidently related to *Xancus* but with sufficient differences that subgeneric separation is desirable. In form, the shell is slender, *Aurinia* or *Scaphella*-like, the sutures are deeply channelled with the superior edge of the whorl not truly shouldered and more often rounded or beveled. The columella has only 2 instead of 3 or 4 plications.

The genus *Xancus* is represented in the Peruvian Eocene by a typical species (*X. peruvianus* Olsson⁴¹) related to *X. wilsoni* Conrad⁴² of the Vicksburg Oligocene of Mississippi. Its stratigraphic range begins in the Restin sandstones of Cabo Blanco and continues through the Saman, Chira and Mancora formations. It would appear that *Xancus* although apparently not represented in the recent and later Tertiary faunas of the West Coast, probably arose through a *Clavilithes* ancestry in the Eastern Pacific during the Middle Eocene. From this center, it spread during Oligocene and Miocene times through the Caribbean region, to Europe and as far east as India and Java. Recent species are found in the Caribbean region, along the coast of Brazil and in the Indian Ocean.

Xancus (*Eoxancus*) *talarensis*, n. sp.

Plate 7, figs. 2, 3, 5.

Shell of medium size, slender with the spire and anterior canal

⁴¹Olsson, A. A., 1928, *Bulls. Amer. Pal.*, vol. 14, p. 89, pl. 21, fig. 5.

⁴²Conrad, T., 1848, *Journ. Acad. Nat. Sci. Phila.*, 2nd series, vol. 1, p. 120, pl. 12, fig. 12.

of nearly equal length and size; protoconch missing; the first 3 turns preserved on our specimens are strongly sculptured with ribs and spirals; this sculpture soon becomes obsolete leaving the 3 last turns practically smooth; on the early spire-whorls, the ribs generally number about 6 to each turn; they are crossed by 6, elevated spiral threads, the lower being more widely spaced; sutures canaliculate or deeply channelled; profile of spire-whorls straight below, rounded or bevelled next to the channelled sutures; last whorl quite large but not inflated, and about three-fourths the length of the whole shell; aperture narrowly subelliptical, more narrowed and pointed at the anterior end; anterior canal long, straight with a slight but noticeable bulge in the middle; columella with 2 sharp, keel-like folds.

Height 65mm.; diameter 26.5mm.; aperture 37mm.

Remarks.—This species is represented by 4 specimens, 3 from Yasila and 1 from Talara. Although closely related to the next species, *paytensis*, it is clearly distinct, differing by its more slender form, more rounded and less shouldered whorls and narrower, less canaliculated sutures.

Locality and Geologic Occurrence—Talara formation, Talara, Yasila.

Xancus (Eoxancus) paytensis, n. sp.

Plate 7, figs. 1, 4, 6.

Shell of medium size, solid; spire and aperture of about equal length; nucleus unknown; post-nuclear whorls probably 8 or 9 in perfect specimens, with straight or weakly convex sides and separated by wide, deep, excavated sutures so that the whorls appear to be narrowly shouldered; the earlier whorls are strongly sculptured with ribs and spiral threads; there are usually 6 ribs to each turn, more or less in line across the sutures; the ribs and their interspaces are crossed by 5 spiral threads, the upper one bordering the excavated suture being largest; on the 5th or 6th whorl, the sculpture begins to fade out and on the later turns, the surface is nearly smooth; anterior canal of moderate length, straight, stout; aperture narrow, the outer lip strongly thickened at its junction with the body-whorl; columella with 2 strong plications.

Height 80mm.; diameter 38mm.; aperture 41mm.

Remarks.—In our collection, this species is represented by 6 specimens, all from the basal Talara beds of Yasila. Four of the

specimens are young shells with strongly sculptured spire-whorls while the other two specimens represent the full-grown and mature form. The sutures lie in a deep, wide channel as in *Busycon canaliculatum* Linné of the recent East American fauna. In this species as in *talarensis*, the columella has only two folds, instead of three or four as in typical *Xancus*.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus *EOVASUM* Douville

Eovasum douvillei, n. sp.

Plate 8, figs. 4, 6.

Shell moderately large, solid volutiform; nucleus not preserved; subsequent whorls $4\frac{1}{2}$ or more, forming a medium height, conic spire; last whorl rather large, shouldered, the shoulder angle armed with strong, spine-like ribs; on the last turn, there are 8 primary ribs with 3 smaller ones of erratic occurrences in certain interspaces; on the penultimate whorl, the spiny ribs are partly concealed by the close, overlapping sutures and lacking entirely from the earliest spire-whorls, but which are closely ribbed from suture to suture; on the body-whorl, there is a medial line of small, knob-like ribs emerging at the upper junction of the aperture and corresponding in their axial position to the stronger ribs above; the siphonal sinus is apparently quite deep and wide, giving rise to an encircling band about the anterior canal and bordered on the posterior side by a low rib or keel; columella straight with 4 folds, the upper 2 much the strongest; outer lip broken.

Height 58mm.; diameter 39mm.; aperture 38mm.

Remarks.—This species based on a single imperfect specimen lacking a part of the outer lip, was collected from the basal Restin shales in the vicinity of the Great Fault north of Negritos. The shoulder of the last whorl is sharp and armed with a row of stout, spine-like ribs which lie partly submerged and covered by the earlier sutures. Midway between the shoulder and the siphonal fasciole is a row of much smaller node-like ribs. There are 4 strong, columella plications.

The genus *Eovasum* Douville⁴³ is based on *Turbinella frequens* Mayer-Eymar of the Egyptian Eocene. The shell is short, stout

⁴³Douville, 1921, Journ. de Conchyliologie, vol. 66, pp. 1-4, pl. 1, figs. 1a, 1b, 2.

and strongly shouldered. The spire is low and flat. A strong melongenoid cord encircles the base and the columella is provided with 4 strong folds. The Peruvian fossil differs by its higher spire and the basal cord is less melongenoid and situated more posteriorly and more than half way between the tip of the canal and the shoulder.

Trechmann⁴⁴ has recorded *Turbinella (Eovasum)* sp. from the Yellow limestones of Jamaica but his specimens are casts and do not show the columella folds and the melongenoid basal cord. *E. indicum* Douville⁴⁵ occurs in the *Cardita beaumonti* beds of India. It has a higher spire than *frequens* but lower than that of the Peruvian species.

Locality and Geologic Occurrence.—Restin formation, just north of Negritos.

Family FASCIOLARIIDAE

Genus CLAVILITHES Swainson

Subgenus CHIRALITHES, n. subg.

Type *Clavilithes cynosuris*, n. sp.

The following is a description of the subgenus *Chiralithes*.

Shell elongate-fusoid, massive, the spire about half the total length; whorls convex, the earlier ones with *Fusus*-like ribs and spirals, the later turns (generally the last 3 whorls) smooth; the sutures are distinct, linear and bordered by an apressed band; anterior canal stout, moderately long, slightly twisted or curved backwards and moderately thickened about the middle; aperture subcircular to subelliptical above, produced and narrowed below into the long, narrow anterior canal; outer lip often thickened in gerontic individuals; inner lip callused, the inner edge of the callus free; growth lines sinuated, forming a broad, concave curve across the upper face of the whorl and between the sutures.

Remarks—*Chiralithes* should probably be considered as a subgenus distinct from *Perulithes* except that *C. pozoensis* Olsson of the basal Talara seems to be a possible transitional form between the two groups. The shell is elongate-fusoid in form,

⁴⁴Trechmann, 1923, The Geol. Mag., vol. 60, p. 355, pl. 17, fig. 7.

⁴⁵Douville, 1929, Pal. Indica n. ser., vol. 10, Mem. No. 3, p. 39, pl. 7, figs. 12, 13, 14, and 15.

massive, the early whorls sculptured after the fashion of *Fusus* with ribs and spirals. The last 3 turns are generally smooth except for growth lines. The whorls are strongly convex, with an appressed sutural band. The anterior canal is moderately long, stout, thickened about the middle but without the ribs or cord of *Streptochetus*. The growth lines are sinuous, with a wide sinal curve across the main face of the whorl. In mature specimens, the inner and outer lip are thickened.

Clavilithes (Chiralithes) cynosuris, n. sp.

Plate 9, figs. 2, 3, 4, 5.

Shell of medium size, solid, fusoid with a long, heavy anterior canal; whorls numerous, slightly convex at first sculptured with about 8 strong longitudinal ribs crossed by regular spiral cords; on the later whorls, the ribs and spirals become obsolete with the shell becoming smooth; protoconch and early nepionic whorls not known; the sculptured whorls are at first evenly convex but soon develop a contracted band or zone just below the upper suture; this sutural band becomes more pronounced on the last whorls where it is quite deep and narrow; body-whorl and the 2 or 3 preceding turns are smooth except for faint spirals, these spirals persisting longest on the sutural zone; anterior canal moderately long, solid and twisted just below the middle and slightly recurved or bent to the right at its tip; aperture obovate to subelliptical above but narrowed and canal-like anteriorly; outer lip simple, thickening in gerontic specimens; inner lip callused, the outer edge free or shelf-like.

Length 58mm.; diameter 27mm.; ($2\frac{1}{4}$ whorls)

55mm.; 19.5mm.; (5 whorls)

59mm.; 21mm.; (4 whorls)

40mm.; 16.5mm.; (4 whorls)

40mm.; 17mm.; (5 whorls)

Remarks. The Chira shales specimens of this species are accepted as the typical form. When perfect, the shell probably reached a length of 80 to 90 mm.; and when mature had a strongly thickened inner and outer lip. Shells from the lower Talara are consistently smaller and the largest specimen in our collection

does not exceed 45mm. The spire whorls for 5 or 6 turns are strongly sculptured with ribs and spirals but shortly afterwards become smooth except for faint spirals persisting on the anterior canal.

Subgenus PERULITHES, n. subg.

Type *Clavilithes peruvianus* Woods

Plate 9, fig. 6.

The following is a description of the Subgenus *Perulithes*.

Shell fusiform, with the spire equal to or much longer than the anterior canal; protoconch unknown; spire whorls rounded or convex, in some species with a shallow sutural zone about the upper edge of the whorl; last whorl convex, rounding into the base; sculpture of ribs and spirals on the early post-nuclear whorls, becoming smooth on the later turns or simply sculptured with spiral threads; anterior canal fusoid, straight to slightly twisted; outer lip thin, probably with a shallow sinal inflexion near the middle; growth lines sinuated with a broad, shallow sinus opposite the middle of the aperture; columella smooth.

Remarks.—In form and sculpture, this group seems intermediate between *Streptochetus* and the true *Clavilithes*. The shell is typical fusoid with a long, often very slender spire and anterior canal. There is a strong sculpture of ribs and spirals on the early post-nuclear whorls, the later turns however become smooth or simply marked with fine spirals. The growth lines show a shallow sinal inflexion opposite the middle of the aperture. From true *Clavilithes* it differs by its rounded not contracted or angulated body whorl so that the shape of the shell is more typically *Fusus*-like.

Perulithes is a very characteristic group of the Peruvian Eocene and besides the typical species *peruvianus* Woods from the basal *Clavilithes* series the following species may be referred to it, *C. Harrisii* Woods (*Clavilithes* series), *C. pozosensis* Olsson and *C. yasilus*, n. sp. from the basal Talara.

Clavilithes (Perulithes) yasilus, n. sp.

Plate 9, figs. 1, 7.

Shell subfusiform, the spire of about equal length to the aperture and anterior canal; whorls 7 or more, those of the spire slightly convex on the lower half, slightly concave or depressed on the upper half, thus forming a shallow sutural band; suture

grooved; the earlier spire-whorls are sculptured with about 7 wave-like ribs which soon become obsolete and are lacking from the last 3 or 4 turns; the last turns when well-preserved have a fine sculpture of revolving, scabrous threads, strongest on the sutural zone and anterior canal, usually lacking on the middle of the last whorl; growth lines somewhat sinuous, with a shallow, sinus-like inflection on the shoulder or middle of the last whorl; anterior canal straight with a narrow aperture; columella straight, smooth.

Length 45mm.; diameter 17mm.; aperture 21mm.; (broken)

Remarks.—From *C. pozoensis* Olsson which this species resembles, it will be distinguished by its more robust form, less slender spire and shallow sutural zone. It also resembles *C. kennedyanus* Harris⁴⁰ but that species has the angulated body whorl of true *Clavilithes*.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Family BUCCINIDAE Troschel

Genus POLLIA Sowerby

Pollia sillapaytensis, n. sp.

Plate 11, figs. 7, 8, 12.

Shell small, moderately slender, recalling a small *Phos* in general form and sculpture; spire rather long, slender nearly 2/3rds the length of the shell; nucleus small, pointed, of about 3 whorls but other characters unknown; post-nuclear whorls about 6; last whorl somewhat convex about the upper one-half, contracted about the base and produced to form a narrow, twisted canal; aperture rather wide, subovate but contracted or emarginate into the twisted, recurved siphonal canal; outer lip slightly thickened and bearing on the columella 4, curving lirae; sculpture consists of *Phos*-like ribs and spirals; on the last whorl there are 7 ribs or axial undulations, strong and heavy on the middle of the whorl but fade out on the base; on the spire-whorls they pass from suture to suture; spiral sculpture consists of fairly coarse primary cords separated by wider interspaces; there are generally 4 primary cords on the spire-whorls and 13 or 14 on the last whorl; one or more finer secondaries are usually present in the spiral

⁴⁰Harris 1895, Proc. Acad. Nat. Sci. Phila., p. 53, pl. 7, fig. 8. Grabau 1904, Smith. Misc. Coll., p. 131, fig. 17.

bands between the primaries.

Length 12.75mm.; diameter 8mm.; aperture 8.5mm.

Length 18.25mm.; diameter 8mm.

Remarks.—This is a small *Phos*-like species sculptured with strong ribs and spiral cords. It recalls the *Tritonidea neglecta* Deshayes of the Parisian Eocene (Cossmann and Pissarro, *Iconographie*, pl. 37, figs. 179-7) but is larger and has a more slender and pointed spire.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Subgenus **ENDOPACHYCHILUS** Cossmann

Pollia (*Endopachychilus*) *purpureoides*, n. sp.

Plate 11, figs. 1, 2, 9.

Shell small, stout, biconic with a pointed spire about half the length of the whorl shell; spire whorls 5+, with straight or slightly concave sides between close, appressed sutures; nuclear whorls unknown; the last whorl is moderately shouldered or angled, above which the surface of the whorl is noticeably depressed or concave; sculpture consists of 9 to 11, low ribs on the shoulder of the last whorl but lacking from the rest of the shell and a spiral sculpture of irregular incised lines forming spiral bands or ribbons of variable width; these bands are quite wide on the anterior half of the shell, close and finer on the sutural area above the shoulder of the last whorl; aperture subelliptical, more or less pointed at the anterior and posterior ends; outer lip thickened, with 4 or 5, heavy denticles; inner lip thickened and bearing 6 or 7, elongated, low denticles; siphonal fasciole narrow, slightly recurved; anal fasciole present at the posterior end of the aperture.

Length 18mm.; diameter 11mm.; aperture 11.5mm.

Remarks.—Associated with this species at Yasila, is a larger form which probably belongs to a different species, but our specimens are so badly weathered or crushed that they are not suitable for the erection of another new species. They differ by their larger size, more *Thais*-like in form, wider subovate aperture, finer spiral sculpturing and entire lack of axial ribs.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus **TEREBRIFUSUS** Conrad**Terebrifusus ? placitus**, n. sp.

Plate 4, figs. 17, 18.

Shell small, subulate with a long spire and shorter aperture; protoconch unknown; post-nuclear whorls 4 or more, straight or slightly convex with the sutures close and indistinct; sculpture is rough and coarse with about 6, distant, low ribs and quite coarse, distant, primary spiral cords; the ribs are nearly in line across the spire-whorls; the spiral sculpture is coarse, *Mitra*-like; on the spire-whorls there are 5 primary cords between wide interspaces; on the last whorl the spirals increase to 10 or more, being closely spaced on the base and anterior canal; there is a single central secondary which is bordered on each side by a finer tertiary thread in each spiral interspace; the surface is covered with close growth-lines so that the resulting sculpture is scabrous; aperture subelliptical; columella and anterior canal short, encircled by a constricted zone and bordered below by a broad, but not too prominent fold arising through the close crowding of the curved growth-lines; columella armed with 5 or more, weak, revolving plaits which are continued as spiral threads around the anterior canal; a moderately deep, siphonal canal.

Length 13mm.; (tip imperfect) diameter 4.25mm.

Length 12mm.; diameter 3.5mm.

Length 11mm.; diameter 3.5mm.

Remarks.—This species is referred with much doubt to Conrad's genus *Terebrifusus* of the Gulf Coast Eocene. In *Buccimitra amoena* Conrad (as *Terebra gracilis* Lea and *multiplicata* H. C. Lea), the type of *Terebrifusus*, the shell is small, *Phos*-like with numerous, small and regular columellar plaits. *F? placitus* from Peru resembles *amoena* in general characters but is more *Mitra*-like and the suture is bordered by a strong, spiral cord.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Terebrifusus ? lepus, n. sp.

Plate 11, figs. 14, 15.

Shell small, *Phos*-like in form and sculpture; protoconch unknown, post-nuclear whorls 4 or more, convex in profile between close, indistinct sutures; whorls sculptured with strong, acute, distant ribs crossed by fine spiral threads; the ribs number about 6, are strong, narrow and separated by much wider interspaces;

the ribs are continuous and in line across the sutures, very slightly oblique to the axis of the shell; on the last whorl they pass across the face of the whorl to the contracted zone or sulcus encircling the beak; the spiral sculpture is formed of fairly regular, distant threads; there are 6 spirals on the whorls of the spire, the uppermost 2 being much smaller and closer together; on the last whorl there are 12 or more spirals; the spiral interspaces are wider than the spiral threads and carrying 2, 3 or more fine secondaries; anterior canal of medium length, twisted with the columella armed with 5 plaits of which the upper ones are much stronger.

Length 12.5mm.; diameter 4.5mm.

Length 10mm. (imperf.); diameter 5mm.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus SIPHONALIA A. Adams

Subgenus PSEUDONEPTUNEA Kobelt

Siphonalia (Pseudoneptunea) nuntia, n. sp.

Plate 10, figs. 14, 15.

Shell small, broad with a high, acute spire; protoconch bulimoid, composed of 3 high, convex, smooth whorls; subsequent whorls 5 in number are strongly convex becoming shouldered on the penultimate and last whorl; sutures close, waved by the ends of the axial ribs; sculpture consists of low, curved, narrow ribs separated by much wider interspaces; these ribs number 9 to 11 on the last turn, are sinuous or convex backwards opposite the middle of the aperture; the ribs begin at the upper suture and extend to the base of the last whorl but not along the anterior canal; the ribs and their interspaces are further sculptured with raised, subregular spiral threads between wider interspaces; there are about 8 threads on the spire-whorls, 13 on the main part of the body whorl with smaller ones on the anterior canal; anterior canal moderately long, curved and twisted; aperture semi-circular, extended forward into the anterior canal.

Height 12.5mm.; diameter 7.5mm.

Height 13mm.; diameter 8.25mm.

Height 15mm.; diameter 7.5mm.; aperture 8.25mm.

Remarks.—Compared with the Siphonalias figured by Cossmann and Pissarro from the Parisian Eocene, this species is nearest *S. (Pseudoneptunea) angusticostata* Mellw from the

Cuisien.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus **PSEUDOLIVA** Swainson

Pseudoliva coronaria, n. sp.

Plate 6, figs. 3, 7.

Shell medium-sized to large, solid; whorls about 5, forming a moderately elevated, globose spire; spire at tip, elevated, pointed; last whorl is sharply shouldered but not ribbed and bordered immediately above by a deep, channelled or grooved suture; the penultimate and spire whorls are strongly convex, callused, turbaned-shaped, between the deep, grooved sutures; surface of body-whorl smooth or marked simply by the longitudinal growth-lines; the *Pseudoliva* groove about the base deep and situated near the anterior one-third; siphonal fasciolar band prominent, narrow and bordered on the posterior side by a keel-like ridge; aperture subovate, outer lip unknown; inner lip with a moderately heavy, parietal callus at its posterior end.

Height 56mm.; diameter 28mm.; aperture 30mm. (Yasila).

Remarks.—The material representing this species, consists of the Holotype from the basal Talara beds of Yasila and three large specimens thickly encrusted with rock matrix from the Saman sandstones of Casa Saman.

In its channelled sutures and callused, turbaned whorls, this shell resembles the members of the *mutabilis* group of the older Peruvian Eocene. It differs constantly by its more elevated spire, absence of ribs on its earlier spire-whorls, narrower body-whorl and shorter aperture. The general effect produced, is that of a more slender shell with the aperture about one-half the total length. *P. mutabilis* var. *douvillei* of the Restin and Parinas, the end member of the *mutabilis* group is a strongly senile or gerontic form developing a very heavy shell and a thick, irregular callus growth over its penultimate and spire whorls.

The Saman specimens are much larger than the measurements given above for the Holotype from Yasila. They are unfortunately thickly encrusted with matrix which forbids their being figured. The two specimens measure as follows:

Height 65mm.; diameter 53mm.; aperture 40mm. (approx.)

Height 75mm.; diameter 65mm.; aperture 50mm. (approx.)

Locality and Geologic Occurrence.—Talara formation, Yasila. Saman formation, Casa Saman.

Family MURICIDAE Tryon

Genus MUREX Linné

Murex scorpionius, n. sp.

Plate 11, figs. 3, 4, 10.

Shell small, fusiform with the spire somewhat longer than the outer lip and anterior canal; protoconch (eroded) seems to be small, pointed; post-nuclear whorls 5 or more, roughly subtriangular in section due to 3 major ribs to each turn; anterior canal of moderate length, straight, with an open canal throughout; sculpture consists of strong ribs of which there are 3 major ones to each turn which on the later turns develop almost into true varices; the major ribs are partly continuous and in line across the sutures; between the primary ribs there is usually a smaller one which unlike the others is quite short and does not extend far along the anterior canal; there are 2 central spiral cords on each spire whorl and a 3rd usually showing in the lower suture; on the body-whorl there are 4 central cords and several irregular ones on the base of the whorl and anterior canal; aperture subelliptical to subovate, narrowed and produced into the anterior canal; outer lip heavily thickened by the last ribs which sometimes carries one or more small spines.

Length 16.5mm.; diameter 8.25mm.

Remarks.—This species resembles *M. contabulatus* Lamarck of the Paris Basin but our shells have no true varices but simple ribs not quite continuous across the sutures. The spaces between the ribs have each a smaller riblet which is not found on *contabulatus*.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus TYPHIS Montfort

Subgenus LEVITYPHIS Cossmann

Typhis (Levityphis) thagus, n. sp.

Plate 12, fig. 6.

Shell small, solid; nucleus unknown; post-nuclear whorls 4 or more, strongly shouldered, each bearing 4 strong, rib-like varices and tubular spines; last whorl of moderate size, strongly convex about the upper $1/2$, contracted below about the base; on the

last whorl, the varices are heavy, rib-like, rounded and continue from the shoulder angle anterior across the face of the whorl to the tip of the anterior canal; the interspaces are wide with a tubular spine on the shoulder not exactly intermediate in position but adjacent to the varix just in front; surface smooth; mouth circular with the last varix forming the outer lip; anterior canal closed.

Length 12mm. (imperfect); diameter 8.5mm.

Remarks.—Our only specimen is fragmentary lacking the tip of the anterior canal and nucleus. It resembles *Typhis coronarius* Deshayes of the Parisian Eocene which species was selected by Cossmann as the type of his subgenus *Levityphis*. *Typhis alternatus* Lea from Claiborne is larger and has a longer spire.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus YASILA, n. gen.

Type. *Yasila paytensis*, n. sp.

The following is a description of the genus *Yasila*.

Shell small, muriciform; spire short, elevated, acute; nucleus of medium size, Bulimiform composed of 3 smooth turns; body-whorl large, inflated and strongly contracted about the base and produced forward into the anterior canal; anterior canal long, narrow, straight and continuously open, with a single columellar plication about the middle; sculpture of strong ribs and spiral threads; aperture sub-circular, narrowed and continued through the anterior canal; outer lip thickened by the last rib, finely denticulated within.

Remarks.—This group represented by two species, *paytensis* from the basal Talara beds of Yasila and *chirænsis* from the Chira shales near Casa Saman, is characterized by its long, straight, anterior canal bearing a single columellar plication about the middle. The axial ribs number, 7, 9 or more to each turn but do not develop into true varices. On some specimens of *paytensis*, the ribs as they cross the shoulder become pointed or even develop into small, sharp spines.

Possessing a columellar plication, *Yasila* would seem to find its relations with *Muricopsis* but in the absence of other charac-

ters too much stress cannot be attributed to this feature. *Odon-topolys* Gabb based on *O. compsorhytis* Gabb a rare Claiborne species of Texas and Alabama has a higher spire, 3 varices and 2 columellar plications. *Peruficus* Olsson is characterized by its *Ficus*-like form and sculpture and 2 columellar plications.

Yasila paytensis, n. sp.

Plate 11, figs. 11, 16, 17, 18.

Shell small with a short but acute spire and shouldered whorls; nucleus as described above; post-nuclear whorls 4 to 4 $\frac{1}{2}$, sharply shouldered, sculptured with 7 - 9 narrow, but strong axial ribs to each turn which extend from the upper suture and across the base of the last whorl but not along the anterior canal; the spirals consists of primary, secondary and tertiary threads; this sculpture is as follows: a primary cord about the suture, 5 threads of secondary strength on the shoulder area, 14 primary threads from the shoulder angle across face of the whorl to tip of anterior canal and separated by wide interspaces each of which carries a central secondary and 1 or 2 tertiary threads on the sides; the ribs as they cross the shoulder angle sometimes become pointed and spine-like; aperture subovate; the outer lip greatly thickened by the last rib; a single *Strepsidura*-like columellar fold; outer lip denticulate within.

Length 13.5mm.; diameter 9mm.; aperture 10mm.

Remarks.—This species is very abundant at Yasila, our collection containing 50 to 75 specimens.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Superfamily TAENIOGLOSSA

Family NYCTILOCHIDAE Dall

Genus PLESIOTRITON Fischer

Plesiotriton paytensis, n. sp.

Plate 10, figs. 8, 10, 11.

Shell small or medium size with a high spire, large body-whorl and a cancellated beaded sculpture; protoconch eroded, small; post-nuclear whorls 6 or 7, together forming a high, rapidly tapering spire; spire-whorls roughly convex, appearing slightly shouldered next to the suture; body-whorl moderately large, ovate, nearly $\frac{2}{3}$ the length of the whole shell; heavy rib-like varices generally spaced about 120 degrees apart; aside from the varices, the general sculpture of the whorls is subcancellate;

axial sculpture of small, numerous, closely spaced riblets which become noded or finely beaded by the crossing or intersection of the spiral cords; there are generally 4 primary spirals on the penultimate whorls, 16 or more on the last whorl; the primary spirals are separated by wider interspaces which carry 2 or 3 smaller spiral threads; aperture narrow elliptical, somewhat contracted and pointed above, continued forward into a short, truncate anterior canal; outer lip heavy, crenulated within; columella straight with 3 or 4 *Cancellaria*-like folds.

Length 13.5mm.; diameter 6.25.; aperture 6.5mm. Yasila.

Length 17.5mm. imperfect.

Length 18mm. (2 last whorls); diameter 11mm.

aperture 11.5mm., Salina

Remarks.—The collection from Yasila contains 15 specimens, the largest which is somewhat imperfect measures 18 millimeters in height. We have also a single specimen from near Negritos of which only the last 2 whorls are preserved. When perfect, this shell must have been about 23 to 24 millimeters in length. The columella is provided with 3 *Cancellaria*-like plications with a smaller 4th just visible below.

Principally on account of its columellar plications, *paytensis* is provisionally referred to the genus *Plesiotriton* of Fisher (type *Cancellaria volutella* Lamarck of the Parisian Eocene) although it does not fully agree with that genus in the position of the varices on the penultimate and spire-whorls. Auinger's genus *Hilda* based on *Triton transylvanicum* from the Miocene of Austria-Hungary is also similarly provided with columellar folds but has only a single labial varix.

The Parisian *P. volutella* has more evenly tapering whorls, its sculpture is smoother, less *Triton*-like and the inner lip is strongly callused. *Eutritonium* (*Plesiotriton*) *Hillegondae* Martin⁴⁷ from the Upper Eocene of Java is very similar to *volutella*. R. Bullen Newton⁴⁸ has described *Hilda turriculata* from the Nigerian Eocene.

Locality and Geologic Occurrence.—Talara formation, Yasila. Salinas near Negritos.

⁴⁷Martin 1914, Samml. des geol. Reichs Mus. in Leiden, p. 150, pl. 10, figs. 111, 111a.

⁴⁸R. Bullen Newton 1922, Bull. 3, Geol. Survey of Nigeria, p. 29, pl. 4, figs. 24, 25.

Genus BURSA ("Bolten") Roeding

Bursa chira, n. sp.

Plate 10, figs. 5, 6, 7, 13.

Shell somewhat flattened dorso-ventrally and with 2 varices continuous across the 3 last spire-whorls towards the apex; whorls about 6; protoconch unknown; earliest post-nuclear whorls without varices, convex and sculptured with about 4, nodulated spiral cords and finer secondaries; on the later turns, heavy varices are found about 180 degrees apart and these are almost in line from one whorl to the next; between the varices, the whorls are moderately humped or angulated forming a sort of shoulder, this shoulder carrying 4 or 5 low knobs; the surface is further sculptured with undulated spiral cords; base of last whorl deeply contracted and with a medium length anterior canal or beak slightly recurved backwards; aperture subcircular to subelliptical, nearly three-fourths the length of the shell and with a deep, groove-like anal sinus at the posterior end; outer lip heavily thickened by the last varix, the actual edge of the lip, thinner, elevated but not deeply fluted by the spiral sculpture; anterior canal narrow and of medium length.

Height 26mm.; greater diameter 21.25mm.; lesser diameter

13.5mm.

Remarks.—Although this is an Oligocene species of the Chira Shales, it is described in this place for comparison with *yasila* of the basal Talara. Comparing with recent species, *chira* resembles most closely *B. neglecta* Sowerby⁴⁹ (*margaritula* Desh.) of the Indo-Pacific region. The *margaritula* as figured by Martin⁵⁰ from the Javanese Miocene is somewhat higher, the varices are less heavy and the beak or anterior canal is much wider. *Bursa caelata* Broderip⁵¹ of the Panama recent fauna but a very rare shell on the Peruvian beaches differs by its heavier spiral sculpture and deeply fluted or frilled outer lip.

Locality and Geologic Occurrence.—Chira formation, Quercotilla.

⁴⁹Sowerby, Conch. Illus. *Renella* fig. 22.

⁵⁰K. Martin, 1899, Die Fossilien von Java, Samml. des Geol. Reichs. Museum in Leiden, Bd. 1, p. 146, pl. 23, figs. 337, 337a, 338, 339.

⁵¹Broderip, 1832, Proc. Zool. Soc., p. 178. Sowerby, Conch. Illus., p. 92, fig. 16.

Bursa chira var yasila n. var.

Plate 10, figs. 3, 4.

Shell small or medium-sized; protoconch helicoid of 3 smooth, rapidly enlarging convex whorls; the last $1/2$ turn of the first post-nuclear whorl is ornamented with 3 or 4, somewhat beaded, widely spaced, primary spirals and much finer spiral threadlets; this stage is brought to a close by the formation of a thickened rib or varix; the succeeding whorls are bursoid, each turn provided with two varices; in some shells these varices are placed 180 degrees apart, resulting in a strongly flattened shell, while in others the varices are weaker, slightly spiral in their arrangement and the dorso-ventral flattening of the shell is less pronounced; each whorl is shouldered or humped and armed with 4 or 5 low knobs between each set of varices; above and below this shoulder, the surface is sculptured with finer beaded spirals; aperture subelliptical with a deep vertically directed anal sinus at its posterior end and a medium length anterior canal; outer lip strongly thickened and crenulated with 7 or 8 denticles within; columella with 5 or 6 plait-like denticles.

Height 18.25mm.; greater diameter 12mm.; lesser diameter

9mm.

Remarks.—In its more usual form, this shell appears to be perfectly distinct from *Chira*, differing by its smaller size, proportionately higher spire and longer anterior canal, weaker varices and consequent less strongly flattened dorso-ventrally and weaker spiral sculpturing. With these shells there is however represented in our collection, a number of small specimens which in all essentials seem to be the young of true *chira*. Until larger collections are available for study, it cannot be decided whether one or more species or varieties of *Bursa* occur at Yasila.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Family AMPHIPERASIDAE**Genus AMPHIPERAS Gronovius*****Amphiperas bullen-newtoni*, n. sp.**

Plate 5, figs. 17, 18.

Shell very small with the anterior and posterior extremities contracted and produced; dorsal side moderately convex (our shell somewhat crushed); ventral side flattened with the aperture

extending lengthwise through the middle; the left or outer lip side widely and evenly rounded; right side strongly rounded in the middle, contracted and produced at the anterior and posterior extremities; surface sculpture with transverse, regular threads of nearly equal size separated by wider interspaces; they are strong on the ventral surface much weaker on the dorsal (this side somewhat weathered); the transverse ribs or threads number 21 to 22 on the outer lip; aperture straight, except at the posterior extremity where it curves slightly to the right, narrow, linear in form; outer lip widely thickened, internally crenulated by the ends of the external sculpture.

Length 10mm.; height 4mm.; diameter 6mm.

Remarks.—A similar species (*nigeriensis* Bullen Newton⁵²) occurring in the Nigerian Eocene is referred by Bullen Newton to *Amphiperas* Gronovius (= *Ovula* Bruguiere, genotype *Bulla ovum* Linnaeus) on account of the absence of any external evidence of a spire, the possession of short, broadly canaliculated extremities and the elongately oval contour of the columellar region. The Peruvian species of which the Holotype is the only specimen known, is only about half as large as the African shell, the aperture is straighter more *Cypraea*-like and the posterior and anterior canals are narrower. In external ornamentation, *nigeriensis* and *bullen-newtoni* agree with *Cyprædia* Swainson and *Cypræovula* Gray. A strongly sculptured *Ovula* has been described by Dall⁵³ as *Ovula* (*Transovula*?) *multicarinata* from the Ocala limestones.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus GISORTIA Jousseau

Gisortia thomasi, n. sp.

Plate 8, figs. 1, 2, 7.

Shell large, very heavy, ovoid-pyramidal with a strongly flattened ventral surface and a high central dorsal hump; the spire is entirely concealed in the adult by callus, this region of the shell is flattened but locally depressed immediately over the spire and on the right and left sides of the posterior canal; when viewed from below, the outline of the base appears broadly elliptical with the right margin more strongly curved or convex than the left, and with the anterior end narrowed, pointed while

⁵²Bullen Newton 1922, Eocene Mollusca from Nigeria, Bull. 3, Geol. Sur. of Nigeria. p. 18, pl. 3, figs. 14, 15.

⁵³Dall 1890, Trans. Wag. Free Inst. vol. 3, pt. 1, p. 164, pl. 10, figs. 10, 11.

the posterior $1/4$ th is quite broad; the right side is not angled as in *G. tuberculosa* and instead carries a broad depression which extends feebly upward onto the dorsal surface; aperture narrow and not much wider at the anterior end; viewed from above, the dorsal surface is pear-shaped with a high, central and very prominent hump; the posterior-dorsal area is flattened, locally impressed, rounding on the sides; the dorsal hump is very high, narrow, prominent and exactly central in position; there is a broad depressed band on each side beginning on the ventral surface and extending upward onto the dorsal; the one on the right is much wider and is partly responsible in the development of a pronounced marginal ridge on the posterior dorsal-ventral margin; this depression extends but a short distance onto the dorsal surface so that the left side of the shell in this region is strongly convex; the left depressed band is narrower but continues quite to the base of the dorsal hump; posterior canal is very deep, ridged on the sides; anterior canal about a quarter as deep as the posterior and curved to the left; columella, inner and outer lip concealed.

Length 118mm.; diameter of base 82mm.; height 70mm.

Remarks.—The discovery of a species of *Gisortia* in the Peruvian Eocene is of particular interest and importance and I am indebted for the privilege of describing the fossil to the generosity of Mr. W. Thomas, Geologist of the Lobitos Oil Fields, who collected the type specimen. It was found together with another but badly broken specimen in the so-called *Venericardia* bed which stratigraphically lies about 1000 feet below the base of the Cabo Blanco or Parinas sandstones at Cabo Blanco. In terms of the Negritos section, this horizon would lie near the middle of the Pale Gredas.

In 1927, there appeared in the Memoirs of the Geological Survey of India, the excellent and exhaustive monograph of the genus *Gisortia* by Vredenburg⁵⁴ which greatly simplifies the study of these curious and valuable guide fossils. Vredenburg recognized three subdivisions of the genus; *Gisortia sensu stricto* (type *Ovula gisortiana* Passy = *Gisortia gigantea* Munster), its section *Palliocypraea* Cossmann (type *Cypraea gastroplox* McCoy) confined to the Australian Eocene, and the subge-

⁵⁴Vredenburg 1927, A review of the Genus *Gisortia* with description of several species. Mem. Geol. Survey of India, Pal. Indica, New Series, Vol. 7, Mem. No. 3.

nus *Vicetia* Fabiani (type *Gisortia Hantkeni* H. and M. Ch.) geographically restricted to the old Tethys or Mesogée seas during the Middle and Upper Eocene. Vredenburg enumerates 36 species distributed through the European, Indian and Australian region. Trechmann⁵⁵ has recorded *Gisortia* cf. *murchisoni* and *postalensis* Oppenheim from the Yellow limestones of Jamaica, associated with a fauna of *Clavilithes*, *Carolia* and large Cerithiums. The above description of *thomasi* from Peru, is the first record of the occurrence of this genus on the mainland of South America. In spite of their large and ponderous shells, these mollusks enjoyed a world-wide distribution in the equatorial and subequatorial region during the Eocene period. A single species, *Cypraea umbilicata* Sowerby has survived to the present day, living with the relic *Trigonia* in waters of moderate depth off the coast of Australia.

In true *Gisortia*, as best exemplified by *gisortiana*, the shell combines to a remarkable degree the external features of *Cypraea* and *Ovula*. The shell is very broad across the posterior portion, contracted and pointed at the anterior, with a high, deep, curved posterior canal. The dorsal surface is simply convex or as in *G. tuberculosa* Duclos with tubercles or nodes situated on the posterior side of the middle. *Vicetia* is more truly *Cypraea*-like, the base subovate, and less narrowed or pointed at the anterior end, the dorsal surface has two transverse ridges separated by a medial, transverse depressed zone.

The Peruvian fossil seems nearest related to *Gisortia tuberculosa* of the Lower Eocene of France, Spain and India. Compared with the excellent figure of Cossmann and Pissarro⁵⁶, the Peruvian fossil, differs as follows: the base is less trigonal and longer, the right and left margins being less angulated; the aperture is straighter, less expanded at the anterior end; the dorsal area has a single very prominent hump, instead of scattered nodes and this dorsal hump is exactly central in position.

In *Vicetia*, a transverse impressed zone crosses the dorsal surface and gives rise to two transverse ridges. In *murchisoni*

⁵⁵Trechmann 1923, The Yellow Limestones of Jamaica, Geol. Mag., Vol. 60, pp. 355, 356.

⁵⁶Cossmann and Pissarro 1910-1913, Icon. comp. des Coquilles Fossiles des Environs de Paris. pl. 32, fig. 161-1.

d'Archiac (*douvillei* Cossmann) these ridges are quite far apart. They are much closer in *G. Jamesi* Vredenburg⁵⁷ so that the two together (as seen in Vredenburg's figure c, pl. 24) are nearly central in position. In *thomasi* there is a shallow transverse groove beginning on the right and left ventral side and extending upward over the dorsal surface. The right one is very short, but the left continues at least to the base of the dorsal hump. In these features as well as the central dorsal hump and straight narrow aperture, the Peruvian fossil seems to occupy a position intermediate between the *Gisortias* of the type of *tuberculosa* and the subgenus *Vicetia*. It further suggests that *tuberculosa* is phylogenetically closely related to the ancestral form which gave rise to *Vicetia* in the Mid-Eocene.

The aperture is completely filled with matrix so that the features of the columella, and the absence or presence of denticles or plications on the inner and outer lip cannot be determined. The dorsal hump is also somewhat broken.

Locality and Geologic Occurrence.—Pale Greda formation, Cabo Blanco.

Family TURRITELLIDAE Gray

Genus TURRITELLA Lamarck

Turritella chira Olsson

Plate 12, figs. 1, 2, 3, 4.

Turritella samanensis and *chira* are both common in the basal Talara beds. In a large collection of these fossils from this horizon, the 2 species often appear to intergrade. In general *T. samanensis* is more slender, the whorls are evenly convex and sculptured with numerous, subequal but not sharp spirals. The nepionic sculpture consists of 3, subequal spiral threads which is soon followed by the mature sculpture of numerous fine spirals. In *T. chira*, the taper is more rapid so that the shell is shorter and more stubby, the whorls are subangular, widest about the anterior half, sloping or excavated towards the upper suture. The sculpture is coarser, with 2 primary spirals about the anterior half, often with a 3rd but smaller spiral just above and much finer spirals on the sutural zone.

Locality and Geologic Occurrence.—Talara formation, Yasila.

⁵⁷Vredenburg 1927, *idem.*, p. 69, pls. 23-25.

Family NATICIDAE Forbes

Genus NATICA Scopoli

Subgenus NERINATICA n. subg.

Type. *Natica* (*Nerinatica*) *paytensis*, n. sp.

The following is a description of the subgenus *Nerinatica*.

Shell small, solid with a large, inflated body-whorl and a low, flat spire; sutures distinct; aperture semicircular, the columellar side straight; umbilicus wide with a low, broad internal rib in the upper part bordered in the lower part by a broad groove or sinus; the internal rib or funiculus emerges near the top of the umbilicus as a broad, thick callus which spreads upward and joins with the parietal callus; sculpture of subregular spiral bands formed by incised spiral lines; operculum unknown.

Remarks.—In its flat spire and banded spiral sculpturing, this group resembles *Sinum* (*Sigaretus*) but differs widely from that genus by its heavier shell and wide, deep umbilicus. In these later characters, *Nerinatica* approaches the true *Naticas* or its related subgenera. In *Natica* Scopoli and its subgenera *Naticarius* Dumeril⁵⁸ (with *N. canrena* Linné as type) and *Stigmaulax* Mörch (type *N. sulcata* Born,) the umbilicus is wide, deep with the internal or funicular rib emerging near the base of the umbilicus and separated from the umbilical wall by a deep groove. In *Nerinatica*, the funicle is much smaller, usually showing simply as a wide, internal fold, occupying the upper part of the umbilicus and bordered below by a broad groove or sinus which forms most of the lower half of the umbilicus. It emerges near the upper end of the umbilicus as a thick callus growth which is continuous above with the parietal callus. The operculum is unknown.

Natica (*Nerinatica*) *paytensis*, n. sp.

Plate 5, figs. 3, 6, 7, 9, 11, 12,

Shell small, solid with a flat spire, partially concealed by the large rapidly expanding body-whorl; whorls about 3 1/2 to 4, the spire-whorls being very small and nearly concealed by the later turns; suture distinct, incised; sculpture consists of banded spi-

⁵⁸Woodring 1928, Miocene Mollusks from Bowden, Jamaica Pt. 2, Carnegie Institution, p. 378.

rals formed between incised spiral lines or grooves; these spiral bands number about 22 on the last whorl from the umbilical edge to the upper suture; on the penultimate whorl just above its union with the outer lip, there are 6 spiral bands; the spiral bands are fairly regular and on a mature shell are generally about 1/2mm in width on the back of the body-whorl; usually the spiral band on the lower side of the suture is somewhat larger than the others; umbilicus wide, deep as previously described; aperture semicircular, oblique, the columellar side nearly straight.

Height 11mm.; greater diameter 12mm.

Remarks.—This species is very common in the basal Talara shales at Yasila and Jaquay Cunas. *Sigaretus* (*Eunaticina*) *aratus* Cossmann from the Pliocene of Karikal may be related species but Cossmann's⁵⁹ figures are poor and do not show the spire and umbilical area clearly.

Locality and Geologic Occurrence.—Talara formation, Yasila and Jaquay Cunas.

Family FOSSARIDAE

Genus TUBA Lea

Tuba peruviana, n. sp.

Plate 12, figs. 9, 10.

Shell small, turbate with a moderately high spire; protoconch unknown; post-nuclear whorls 6 or more, strongly convex, often becoming shouldered or flattened above; last whorl rather large, convex with a circular or cyclostomous aperture and continuous peristome; sculpture of numerous, elevated and finely beaded spiral cords, usually alternating in strength on the last whorl; the spiral cords are finely beaded by the crowded growth lines.

Height 10.25mm.; diameter 7mm.

Remarks.—Two specimens from the basal Talara beds near Lagunitas are accepted as the types for this species. Another specimen from Yasila badly crushed may possibly belong to a different species. The Lagunitas shells have strongly shouldered whorls with a coarser and more irregular sculpture.

⁵⁹Cossmann, *Essais de Paleoconch. comparee*, vol. 13, p. 149, pl. 3, figs. 16, 17.

Locality and Geologic Occurrence.—Talara formation, Lagunitas, Yasila?

Superfamily PTENOGLOSSA

Family EPITONIIDAE Dall

Genus EPITONIUM Bolten

Subgenus ACRILLA H. Adams

Epitonium (Acrilla) peruvianum Olsson

Plate 4, figs. 12, 13.

Epitonium (Acrilla) peruvianum Olsson, 1928, *Bulls. Amer. Pal.*, vol 14, p. 54, pl. 12, figs. 10, 12.

E. peruvianum and the following *paytense* are very characteristic of the basal Talara or horizon of the Lomitos conglomerate. Being very long and slender, the fossils are usually broken in being removed from their matrix if the rock is at all hard. *E. peruvianum* is refigured here from more perfect specimens than were available at the time the species was described. The shell figured by Bullen Newton⁶⁰ from the Nigerian Eocene as *Acrilla* cf. *affinis* (Deshayes) bears much resemblance to this species.

Epitonium (Acrilla) paytense, n. sp.

Plate 4, figs. 14, 15, 16.

Shell small, slender with numerous coronated whorls; the taper of the shell is more rapid than *peruvianum* and with the upper 1/3rd of the whorl strongly coronated or flattened above; sutures close, distinct; varices numerous, small, there being about 19 to the average-size whorl; they are generally oblique to the axis of the shell; on well-preserved specimens, the varices appear to be divided by a medial line; intervarical spaces are much wider and coarsely sculptured by strong spiral cords there being about 6 or 7 below the coronated shoulder; a basal disc is present; aperture not fully preserved.

Length 16mm.; diameter 4.5mm. (8 whorls)

Length 17.5mm.; diameter 6mm. (8 whorls broken)

Remarks.—Associated with *E. peruvianum*, this species is always less abundant and easily recognized by its strongly coronated whorls.

Locality and Geologic Occurrence.—Talara formation, Yasila, Lagunitas.

⁶⁰Bullen Newton 1922, *Bull. 3, Geol. Sur. of Nigeria* p. 50, pl. 3, figs. 10-12.

Class SCAPHOPODA

Family DENTALIIDAE Gray

Genus DENTALIUM Linné

Dentalium mancorens, n. sp.

Plate 12, figs. 12, 13.

Shell of medium size to large, solid, finely ribbed on the posterior portion becoming smooth and polished on the anterior half; the shell is moderately curved with an even taper; apical characters not known; the posterior part of the shell is finely ribbed, the ribs being nearly even, elevated ridges with much wider, concave spaces between; the ribs gradually become obsolete and most of the anterior portion of the shell is smooth and polished; growth-lines evident, oblique in plane to the axis of the shell.

Length 57mm.; greater diameter 7mm. (Holotype).

Length 55mm.; greater diameter 6.5mm.

Length 44mm.; greater diameter 7mm.

Length 43mm.; greater diameter 6.25mm.

Remarks.—The above measurements are all based on fragmentary specimens. Some basal sections are nearly 9mm. in diameter so that a mature shell was probably more than 70 mm. in length. Its posterior portion has a diameter of about 1.5mm. It is sculptured with stronger, primary ribs which it is estimated number about 18. When the shell has attained a diameter of 2.5mm., secondary ribs appear in the interspaces which rapidly increase so that on the later portion of the test, the ribs are all subequal in size. On the posterior portion, the interspaces are finely etched by the closely spaced lines of growth.

This *Dentalium* was found in great abundance in a hard, flinty concretionary rock lying loose in Que. Barrancas, a south tributary of Que. Mancora near Catalinas. The geological formations in this area belong mainly to the Lower Talara shales and sandstones. Besides this species of *Dentalium*, there are fragments of several gastropods, *Aturia alabamensis* var. *peruviana*, *Nucula catalina* and *Leda barranca*. The rock matrix being so very hard and splintery, most of the specimens are broken or destroyed before they can be extracted.

Locality and Geologic Occurrence.—Talara formation, Que. Barranca.

Dentalium yasilum, n. sp.

Plate 12, figs. 14, 15, 16, 17, 18, 19, 20.

The shell is moderately to strongly curved and that chiefly in the posterior portion; taper of the shell in the apical region is quite rapid until it has attained a diameter of about 3mm., after which the taper is much slower and more uniform; apical section strongly hexagonal which is maintained until the shell has reached a diameter of 2mm., after which the section becomes circular; on the apical portion there are 6 primary ribs between which smaller and finer ribs are gradually introduced; on the mature portion of the shell, the ribs have become very numerous, quite fine; between the primaries there may be 1 or more secondary ribs; on well preserved shells the space between the ribs is very finely etched by growth lines.

Length 30mm. (imperf.); basal diameter 5mm. (somewhat flattened).

Remarks.—Two species of *Dentalium* have been described from the basal Talara or Lomitos conglomerate by Willard Berry⁶¹ as *D. samanimum* and *D. Boggsi*. Both species are based on fragmentary specimens or tips collected in a trench section through the Lower Talara shales near Lagunitas. *D. Boggsi*, an apical portion, has a fairly rapid taper and curved shell. Its cross-section is circular and not hexagonal as in *yasilum*, with 16 nearly equal, regular ribs or costae. In *D. samanimum* the ribs number about 30 and alternate in strength. The type specimen of *samanimum* is a small shell with a maximum diameter of 2.2mm. Specimens of *yasilum* of that size have a much more rapid taper.

D. yasilum is very abundant in the basal Talara beds at Yasila and should be easily recognized by its hexagonal tip and fine ribbing. The ribbing although becoming very fine, is persistent through the entire life history. *D. mississippiense* Conrad⁶² from Vicksburg in its mature form resembles *yasilum* but its apical

⁶¹E. Willard Berry 1926, *Nautilus*, vol. 40, p. 19, 20.

⁶²Conrad 1848, *Journ. Acad. Nat. Sci. Phila.*, 2nd series, vol. 1, p. 112, pl. 11, figs. 1.

taper is more gradual and has 12 instead of 6 primary ribs.

Locality and Geologic Occurrence.—Talara formation, Yasila.

ADDITIONAL SPECIES

Tornatellaea ? sp.

Plate 12, fig. 11

Figured specimen from Yasila. Also occurs in the Chira shales but all our specimens are filled with matrix, concealing the internal features of the outer lip and the columella.

Tritonium (Sassia) sp.

Plate 10, fig. 9

This species seems to be a true species of *Sassia*, resembling Cossmann's figure of *T. (Sassia) apenninicum* Sassi. It also resembles *T. antiquum* Deshayes from the Thanetian. The figured specimen from Yasila.

Peruficus lagunitensis Olsson

Plate 12, figs. 5, 7, 8.

Peruficus lagunitensis Olsson, 1929, *Bulls. Amer. Pal.*, vol. 15, No. 57, p. 26, pl. 8, fig. 11.

Refigured from Yasila specimens. Figure 8 shows the two columellar folds.

EXPLANATION OF PLATE 1

Figure	Page
1. <i>Venericardia planicosta</i> var. <i>samanensis</i> Olsson Length 89 mm. Yasila.	21
2. <i>Nucula catalina</i> , n. sp. Holotype, length 12 mm. Que. Barranca.	18
3. <i>Leda (Ledina) barranca</i> , n. sp. Cotype, length 17 mm. Posterior extremity of right valve. Que. Barranca.	19
4. <i>Glycymeris peruviana</i> , n. sp. Holotype, height 13.5 mm. Yasila.	20
5. <i>Phacoides (Pseudomiltha ?)</i> , sp. Height 93 mm. Que. Monte Grande.	22
6. <i>Leda (Ledina) barranca</i> , n. sp. Holotype, length 26 mm. Que. Barranca.	19
7. <i>Leda (Ledina) barranca</i> , n. sp. Cotype, length 23 mm. Que. Barranca.	19

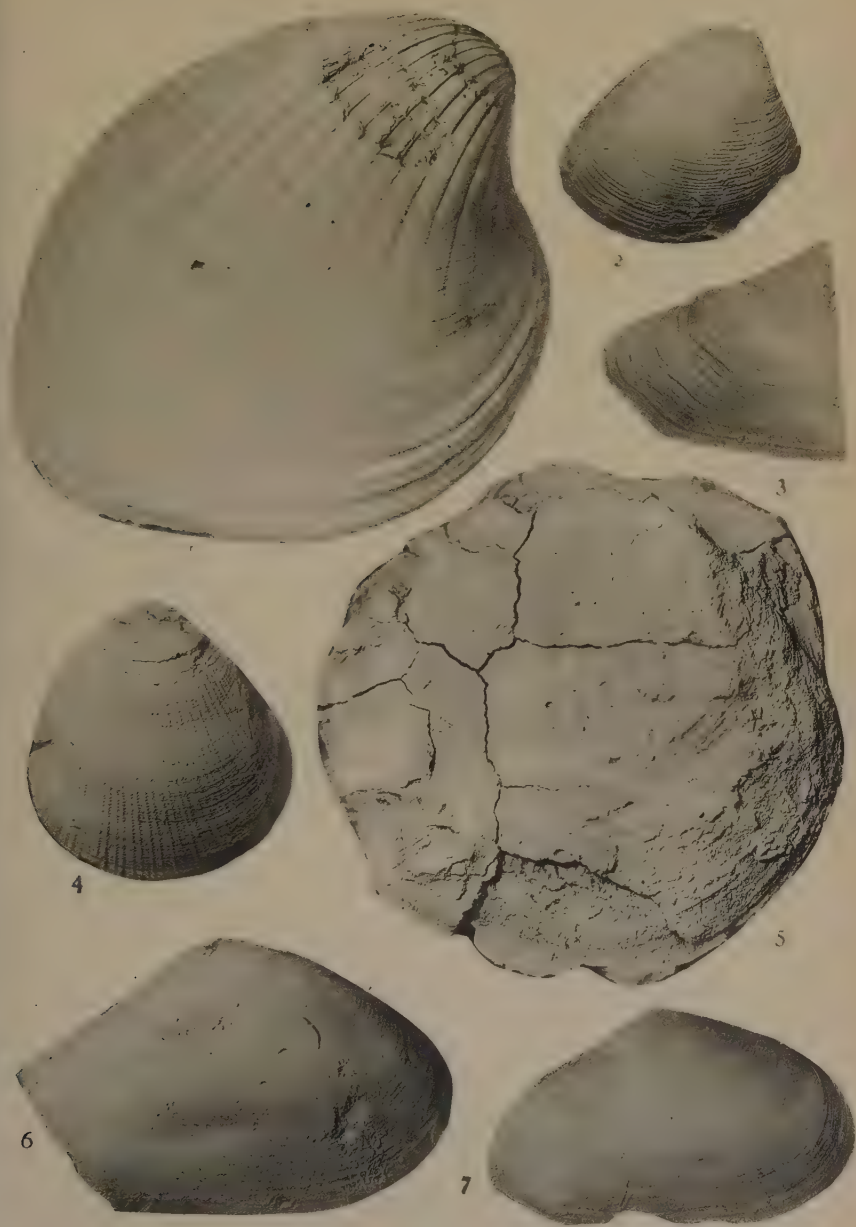


PLATE 2

EXPLANATION OF PLATE 2

Figure	Page
1. <i>Pitaria baldryi</i> , n. sp.	27
Holotype, length 20.5 mm.	
Yasila.	
2. <i>Pitaria baldryi</i> , n. sp.	27
Cotype, length 16.5 mm.	
3. <i>Venericardia simillina</i> , n. sp.	21
Holotype, length 18 mm.	
Yasila.	
4. <i>Cardium junceum</i> , n. sp.	25
Holotype, length 15.5 mm.	
Yasila.	
5. <i>Phacoides</i> (Here) <i>andersoni</i> , n. sp.	24
Cotype, height 8.25 mm.	
Yasila.	
6. <i>Phacoides</i> (Here) <i>andersoni</i> , n. sp.	24
Holotype, height 8.25 mm.	
Yasila.	
7. <i>Phacoides</i> (Here) <i>andersoni</i> , n. sp.	24
Cotype, height 7.50 mm.	
Yasila.	
8. <i>Phacoides</i> (Here) <i>nonurensis</i> , n. sp.	25
Holotype, length 20.5 mm.	
Nonura Bay.	
9. <i>Phacoides</i> (Miltha) <i>woodi</i> , n. sp.	23
Cotype, length 27 mm.	
Yasila.	
10. <i>Cardium junceum</i> , n. sp.	25
Cotype, height 15 mm.	
11. <i>Pitaria yasila</i> , n. sp.	26
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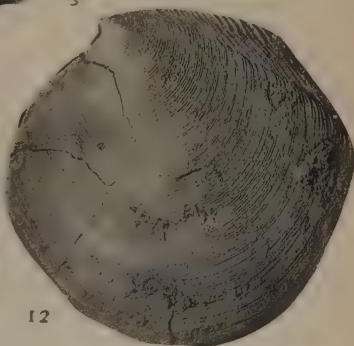
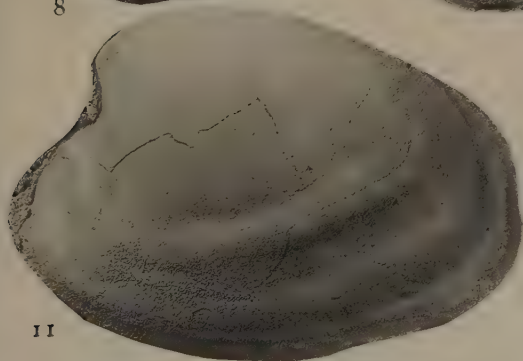
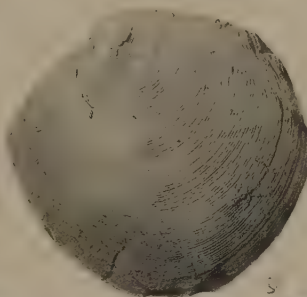
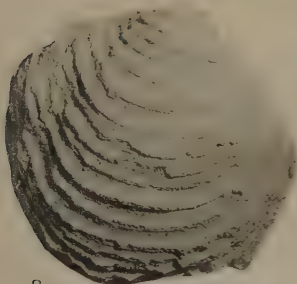
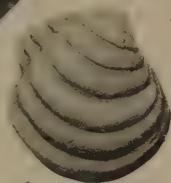
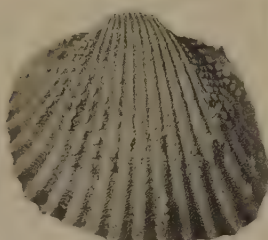
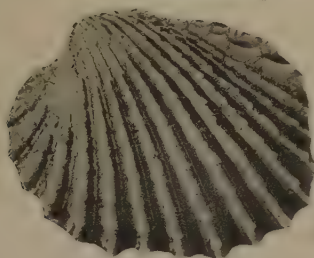
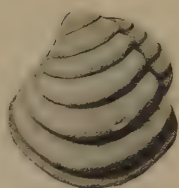
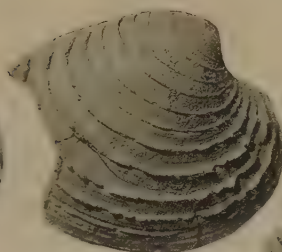
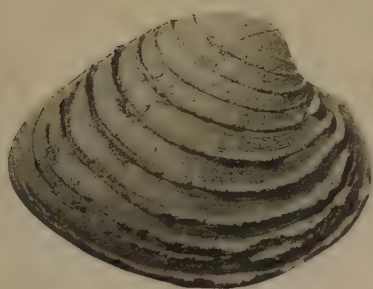


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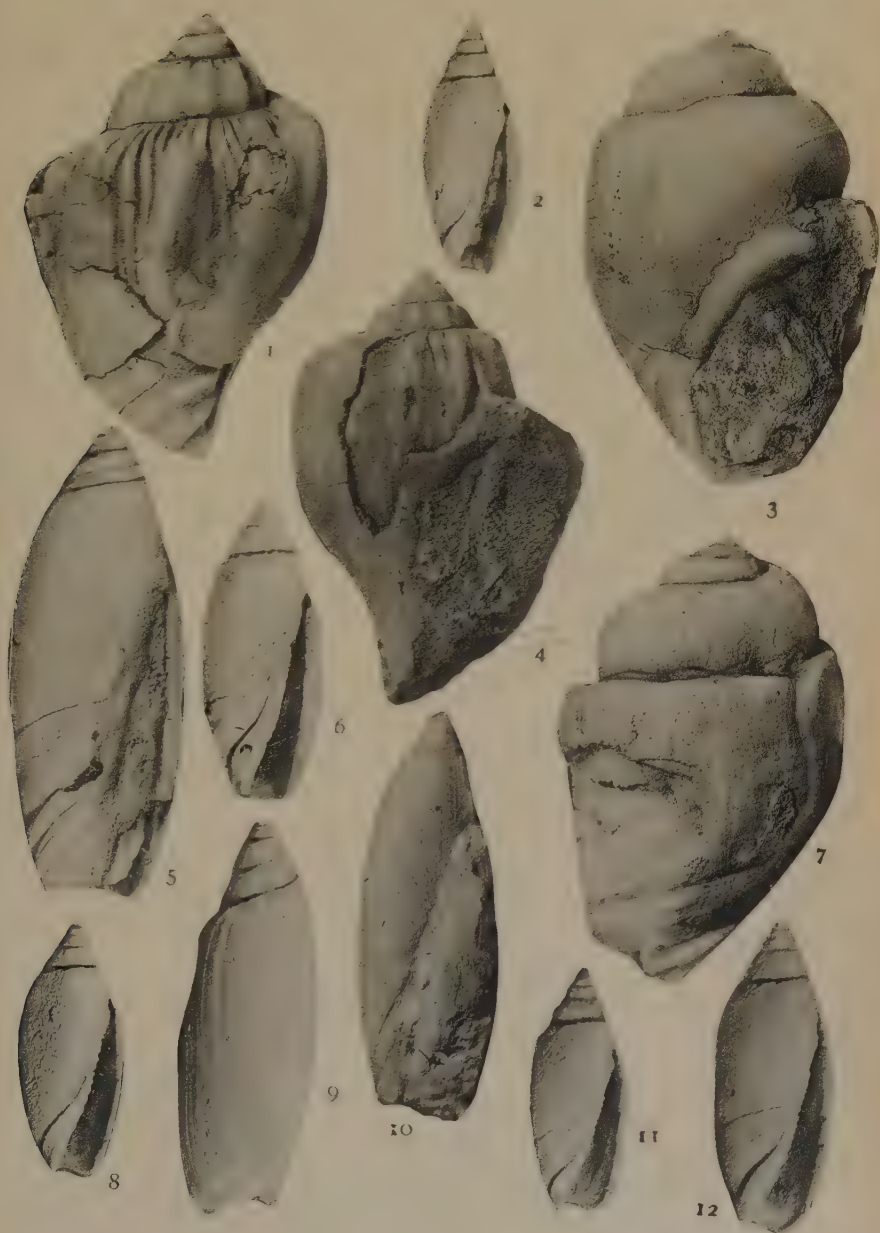


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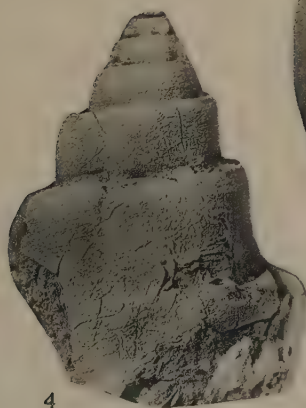
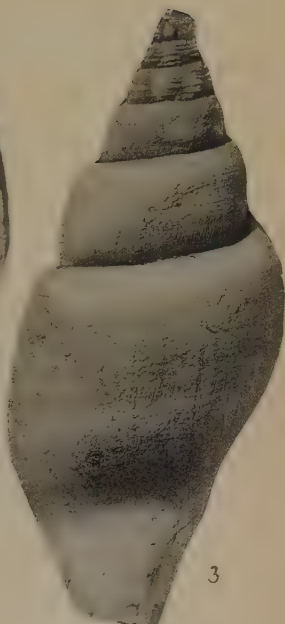
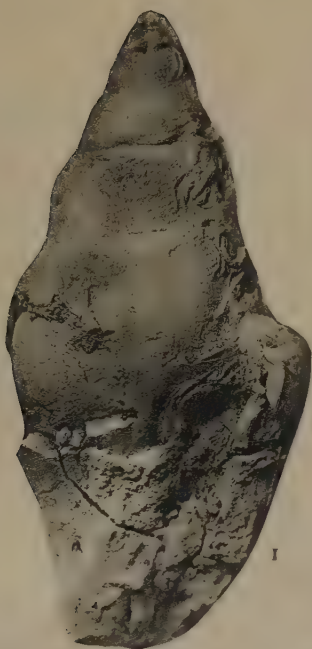


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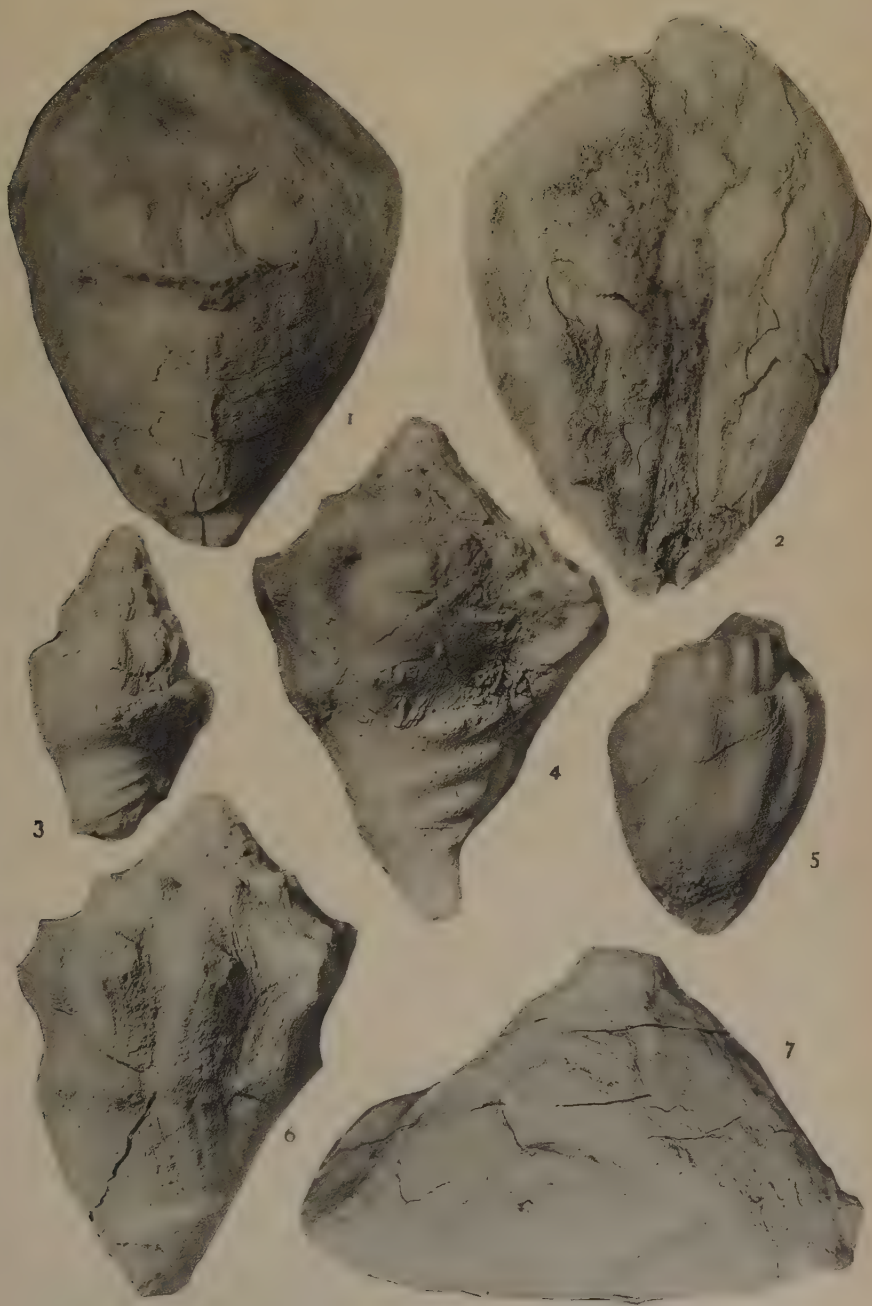


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